ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

FEBRUARY 1957

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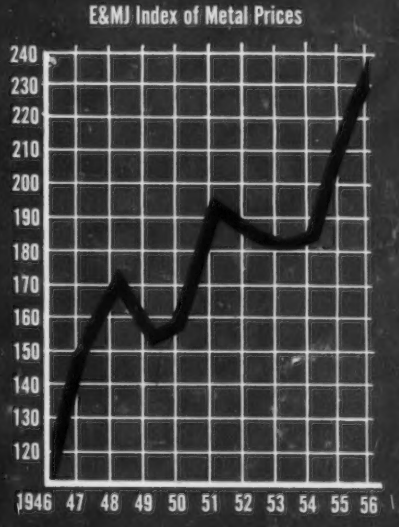

88TH Annual Survey And Outlook

GOLD
SILVER
COPPER
LEAD
ZINC
ALUMINUM
URANIUM
IRON ORE
MAGNESIUM
TITANIUM
TIN
MERCURY
LITHIUM
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BISMUTH
PLATINUM
THORIUM
RARE EARTHS
NICKEL
COBALT
MANGANESE
CHROMIUM
TUNGSTEN
MOLYBDENUM
SULPHUR
PHOSPHATE
ASBESTOS
VERMICULITE
PERLITE
GYPSUM
BARITE
FLUORSPAR
FELDSPAR
MICA
POTASH
MINING
MILLING
IRON ORE BENEFICIATION
METALLURGY

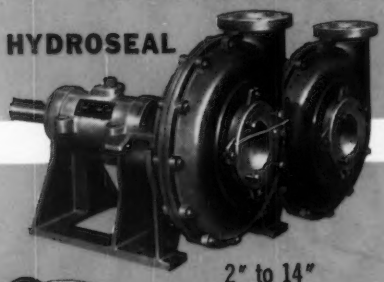
Pumping abrasives, corrosives?

Here's the help you need

INTERCHANGEABLE

HYDROSEAL **CENTRISEAL**

SLURRY



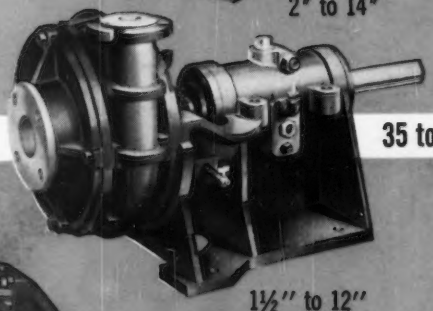
400 to 8 mesh

Delivers pulp undiluted

2" to 14"

HYDROSEAL

SAND

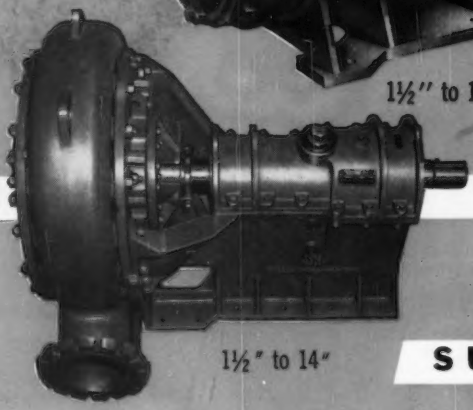


35 to 4 mesh

1½" to 12"

HYDROSEAL

DREDGE



3 mesh & over

1½" to 14"

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Slurry, Sand, Dredge

1½" to 6"

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SAND, SLURRY & DREDGE PUMPS

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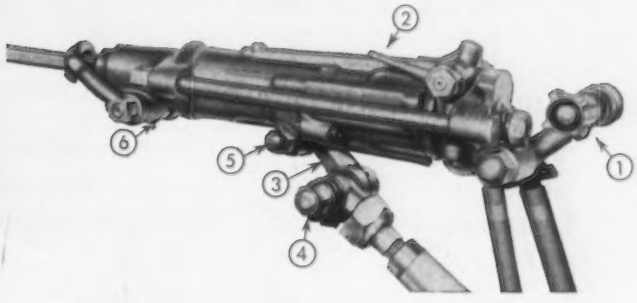
Ten Reasons Why the JR-38B

UNIVERSAL JACKDRILL

makes rock drilling a FASTER, EASIER one-man job

These Jackdrill features make the JR-38B the fastest-drilling, easiest-handling universal drilling unit ever developed



1 **Roll-Type Feed-Leg Valve,** built into handle, gives smoothly variable control from zero to full air pressure — can be reversed for right or left hand operation.

2 **Five Position Throttle** controls all functions — hole cleaning, shut-off, leg-feeding, hole collaring and drilling.

3 **Built-in Air Connection** between drill and feed leg eliminates third hose, simplifies setup and operation.

4 **Adjustable Tension** on hinge joint for easier handling.

5 **Adjustable Balance** shifts drill forward or backward to suit operator.

6 **Enclosed Steel Centralizer** has all working parts protected against dust and dirt.

7 **Constant Chuck Blowing** lubricates front end — keeps drill free of cuttings.

8 **One-Piece Chuck** with renewable recessed bushing — deflects air to side, protects operator against water splash.

9 **Rigid Construction** with fronthead recessed into deep counterbore. Built to stay on the job!

10 **Lighter Weight.** Telescopic feed leg weighs 10 lbs less than previous design. Much easier to handle.

CARSET JACKBIT IR

Longer-Lasting Carset Jackbits and the Faster-Drilling JR-38B JACKDRILL make an unbeatable drilling combination

THIS completely-integrated Jackleg Drill is designed to take full advantage of faster-drilling 1¾" Carset Jackbits — saves air consumption, saves powder, cuts bit and steel costs too. Use it as a drifter, a stoper or a Jackhamer. Ask your I-R representative for complete information or send for Bulletin No. 4144-A.

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ENGINEERING AND MINING JOURNAL

91st YEAR OF PUBLICATION

VOL. 158 NO. 2

FEBRUARY 1957

88th Annual Survey and Outlook

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Published monthly with an additional issue in mid-June by McGraw-Hill Publishing Co., Inc., James McGraw (1860-1948), founder.

Executive, Editorial, Advertising and Subscription Offices: **McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Publication Office:** 1309 Noble St., Philadelphia 23, Pa. Donald C. McGraw, president; Joseph A. Gerardi, executive vice president and treasurer; John J. Cooke, secretary; Nelson Bond, executive vice president, publications division; Ralph B. Smith, vice president and editorial director; Joseph H. Allen, vice president and director of advertising sales; A. R. Venezian, vice president and circulation coordinator.

Subscriptions: Address correspondence to **Engineering and Mining Journal—Subscription Service, 330 West 42nd St., New York 36.** Allow one month for change of address.

Subscriptions are solicited only from management, production and maintenance executives and engineers in the metal and nonmetallic mining and refining industry. **Position and company connection must be indicated on subscription orders.**

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Price of this issue $1.00. Subscription rates: United States and possessions $3 a year; $4 for two years; $5 for three years. Canada, $5 for a year; $8 for two years; $10 for three years. Other Western Hemisphere and Philippines, $8 a year; $12 for two years; $16 for three years.

Elsewhere $15 a year; $25 for two years; $30 for three years. **Please indicate position and company connections in all subscription orders.**

Entered as second class matter May 24, 1951 at the Post Office at Philadelphia, Pa., under the Act of March 3, 1879.

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LETTERS

The Fight for Antimony

Dear Sir:

I have fought for antimony seventeen years, organizing the largest and richest group of properties in the United States—the first mining corporation organized by a woman. Some years ago your magazine gave a very fine article on my work which has become nationally known.

We have written to all Federal and State Bureaus of Mines, mining associations in U. S. and Alaska, for lists of antimony mine owners, and mailed a letter to them which states in essence:

We, who are interested in antimony ore, feel that this is a crucial period as to the placing of antimony on the long-range National Minerals Program bill, which is to come up before Congress soon.

This ore has been so long neglected and there are many antimony mine owners. We import 96% of antimony—only 4% being produced in our country. The Government is still buying to complete our stockpile. Please write to your Senators and Congressmen to take up the matter of placing antimony on the bill, together with the other strategic minerals. In your letters you might include the following:

1. We would like an equitable price through tariffs, excises, payments from tariff receipts or subsidies.
2. Please ask that your representatives contact the Hon. Arthur S. Flemming, director of ODM, as well as the Hon. Fred A. Seaton, Secretary of the Interior.
3. Please ask for a long-range program.

Alma Dorothy Priester
6853 Camrose Dr.
Hollywood 28, Calif.

New Brazilian Zinc Deposit

Dear Sir:

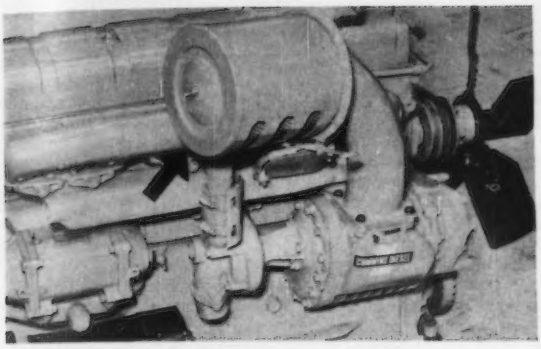
The new zinc deposit in the Vazante Area, Minas Gerais, Brazil, that was announced in a Geological Survey press release on Aug. 21, 1956, has received considerable attention in the mining press in both the United States and Brazil. The press release announced the availability for public inspection of the preliminary report by a USGS geologist, working in cooperation with the National Department of Mineral Production, Brazil, under auspices of the International Cooperation Administration. As the release was short, it gave little beyond the location, form, mineralogy, and gross dimensions of the deposit, and was intended solely to call attention to the availability of the open file report in which considerably more information was presented, including the following acknowledgment of the previous investigations by our Brazilian colleagues:

"The occurrences of non-ferrous mineralization in Vazante area of northwestern Minas Gerais was first reported by Dr. Luciano Jacques de Marais in a paper presented before the IX Congress of the Sociedade Brasileira de Geologia. The

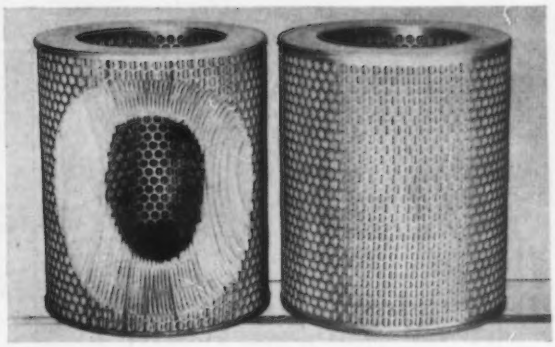
(Continued on p 178)

E&MJ NEW PRODUCTS DIGEST

James W. Franklin



FABRIC air cleaners are standard on Cummins diesel engines.



FABRIC filter resembles Purolator's well known oil line filter.

Cut Engine Maintenance With Fabric Air Cleaner (1)

Earthmovers and stationary gasoline and diesel equipment working in dust-laden atmospheres can take advantage of recent tests on Puralator Products, Inc.'s Micronic air filter. Results of these tests on large over-the-road truck fleets and NASCAR 100-mile races, show that you can get more horsepower, less operating troubles, less down-time and longer oil-life in your equipment by using a dry, fabric-arrester type intake air cleaner, rather than standard baffle-oil cleaner.

In this new filter, thoroughly tested and proven as we will see below, the air passes directly through the resin-impregnated cellulose, leaving the dirt on the outside, passing clean air to the carburetor. In contrast, oil-baffle cleaners rely on drop-out and accidental contact with the oil to remove some of the dirt. Those familiar with dust collecting problems know that a drop-out collector isn't of much use under 200 mesh; and engine tests show that more than 70% of the particles entering an engine are less than 2 microns in size.

First test work was on a large fleet truck (20,000-mile test) where the following startling results were realized:

	Dry filter	Standard air cleaner
Fuel dilution	2.2%	3.4%
Water content	1.0%	3.5%
Sludge	8.4%	12.8%
Fuel soot	8.5%	12.0%
Carbon	1.5%	7.0%
Abrasives	1.0%	10.2%

Present day engines have tremendous power, higher speeds and closer engine tolerances. A more efficient dust collector is needed to get the most service-life out of these units and keep them running at top performance. Most of the damage to vital engine parts is caused by abrasive dust striking the parts after entering the machine through the air cleaner.

The fleet test above not only showed that engine wear could be decreased with this filter, but also that oil filter changes could be spread out for longer oil filter service-life, since there were less abrasives entering the engine. Down-time during the 20,000-mile test was noticeably below normal.

Based on these facts, several engine manufacturers conducted tests of their own and switched to dry Micronic filters (Cummins for one). And automobile makers are looking over the idea.

Second test used a tractor loader working under such several bauxite dust conditions that normal engine life was 100 hr running time. Conditions were so bad that standard air cleaner had to be changed every 4 hr, but a Micronic unit lasted 8 hr, removing dust so efficiently that the engine's manifold remained dust-free for 570 running hours. At end of this time, engine had shown no loss in horsepower.

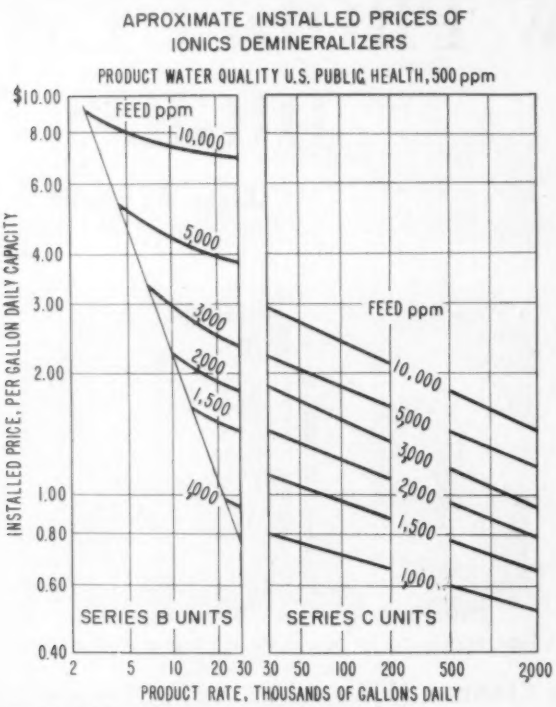
With this dry-type arrester, service managers now can leave an engine in service up to 50,000 miles of over-the-road driving, before calling for air cleaner change. It takes about a minute to replace a dry filter and no oily mess.

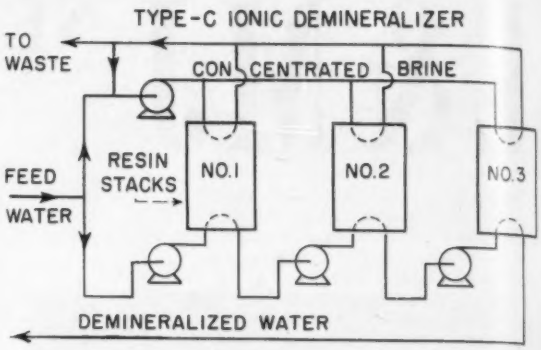
A clincher in favor of dry units came from a 100-mile NASCAR race, where Chrysler engines were tested, using both standard baffle filter and fabrics. Results were outstandingly in favor of the fabric method.

Standard filter controlled engine showed 0.030-in. cylinder wear, while fabric filtered engines showed only 0.0028-in. loss. In addition, Micronic fabric filters left engines showing no clay deposit on top of pistons and no increase in ring clearance. On the other hand, baffle filtered engines showed considerable clay and ring wear. See table for complete results:

	Micron filter	Standard filter
Cylinder wear	0.00028 in.	0.03 in.
Top ring gap increase	None	0.093 in.
Top ring land increase	None	0.029 in.
Oil ring gap	None	0.078 in.
Piston top	Clean	Clay covered
Piston top wear	None	0.007 in diametra
Compression loss	None	40 lb
Horsepower loss	None	Out of commission
Crankshaft condition	No change	Egg-shaped
Rod and main bearings	No change	Replaced
Oil filter	No change	Replaced
Oil	Clean	Very dirty
Crankcase	Clean	1/8-in. sludge layer
Carburetor	Clean	Plugged

Continued on page 36. For more information on these items, use card opposite page 42.





Fresh Water From Saline Sources (3)

To remove dissolved solids (salt, chlorides, sulphites, gypsum, hardness, alkalinity) from water supplies for drinking, laboratory or process use, try ionic membrane separation and purification process as developed and offered by Ionics, Inc.

Ionics makes two series of demineralizers: Series B can deliver up to 28,000 gal daily; Series C can hit the multi-million gal mark. Process uses electric current plus ion-exchange resins in sheet form to make good water out of bad. While electrical consumption depends on condition of raw feed water, the average kwh figure is 7 per 1,000 gal for each 1,000 ppm reduction in Series C equipment.

Ionics units are automatic, operate around the clock with little supervision and brief maintenance. For estimation purposes, the capital cost can be seen in graph opposite.

For water-scarce areas, units can be skid-mounted; trailer-mounted or permanently installed, like the 86,400-gal plant going in at Bahrain Island, Persian Gulf.

Basic operating principle is this: ions in solution are driven by electric current toward and into ion-exchange resins, producing a demineralized water and a brine, as shown in sketch above. Outside of electricity, the only other operating cost is replacement of ion-exchange membranes. To date, cost estimates show that for Series B units (to 28,000 gpd), the cost is less than $1,500 a year for membranes.

Truck Crane (2)

Pitman Hydra-Lift, manufactured by Pitman Mfg. Co., is now available with cab-beside-the-engine design to permit operator to drive truck and run crane from same position.

100-Ton Railroad Hopper (4)

Baldwin-Lima-Hamilton is presently building sixty-five 100-ton coal-carrying high-side gondolas, fitted with air-operated clam-shell bottom-dumpers. Cars are intended for Missouri coal miner.

Six-Wheel Truck (5)

Heavy-duty, six-wheeler, all-wheel-drive trucks are available from International Harvester Co. in four gross-weight classes from 22,000 to 33,000 lb. Company also has two four-wheel models with 19,000- and 20,000-lb class.

Small Back Hoe (6)

Truck-mounted unit, developed by Mid-Western Industries, Inc., can be fitted to any one-ton flat-bed. It has 200-deg working arc and three positions on the mounting rack.

Versatile Skid-Shovel (7)

Three-yard Drott TD-18, by International Harvester Co., can be used as clamshell, bullshell scraper and as a bulldozer in addition to its normal skid-shovel duties. Unit has 134 hp.

Mobile Rotary Drill (11)

High-powered mobile rotary drill, B-52 Pacemaker, handles auger boring, core and percussion drilling as well as soil sampling. Complete and integrated and Mobile Drilling Inc. reports that it can go to 1,000 ft with A-rods.

Self-Dumping Granby Car (12)

Sanford-Day Iron Works, Inc. offers a 10-ton, self-dumping car that operates on pair of hydraulic cylinders that tip car to 40 deg. No fixed dumping point or ramp is needed.

Rotary Blastholer Drill (13)

Called the Blastholer, this rig is self-propelled, can cut 11-ft holes in 20 seconds. Comes equipped with compressor, says Drilling Accessory & Mfg. Co. and will drill holes 2¼ to 3⅞ in. dia.

Aircomatic Welding Process (14)

Inert gas welding process developed by Air Reduction Sales Co. back in 1948, can now be used to cut non-ferrous metals as well as weld them.

Truck Air Conditioner (8)

Kab Kooler by D. W. Onan & Sons Inc. will make the driver more efficient and comfortable. Comes in 1½-ton cooling capacity.

Rock Drill Uses Drifter (9)

Drillcat rig can cut drill time 30%, says Thor Power Tool Co. Crawler-mounted rig is equipped with Thor's 105M drifter rock drill.

Hydro-Boom Shaft Jumbo (10)

Ingersoll-Rand Co. has a shaft sinking machine that can be set up in 15 min. Unit offers new time saving opportunities on sinking jobs.

Radioactive Dynamite

Idea was first introduced at November 1956 CIMM meeting in Vancouver, B.C. and has been tested with good results. After blast, a geiger counter can scan face for unexploded sticks. Product has not been marketed as yet.

Silicate Paint (15)

Can be sprayed, yet be dry to touch in a few minutes, according to Allied Porcenell, Inc., who say that Profilm will resist acids, alkali, moisture and salts on almost any surface.

Continued on page 38. For more information, use card opposite page 42.

Illustration from Agricola's De Re Metallica (1621)

Arduous Work—Small Production

In centuries past, the production of metals could be measured by handfuls. Small wonder when comminution was done by a hammer and beneficiation was limited to hand-picking.

Fortunately, today's modern processing plants treat many tons of ore and produce many tons of metals, thus making possible our "metal age" civilization. This large production requires modern grinding methods which in turn utilize such grinding media as those produced by CF&I. The grinding balls and grinding rods produced by CF&I are *always* made from special analysis steels with the ideal balance between toughness and hardness to assure optimum grinding ability and maximum wearing ability.

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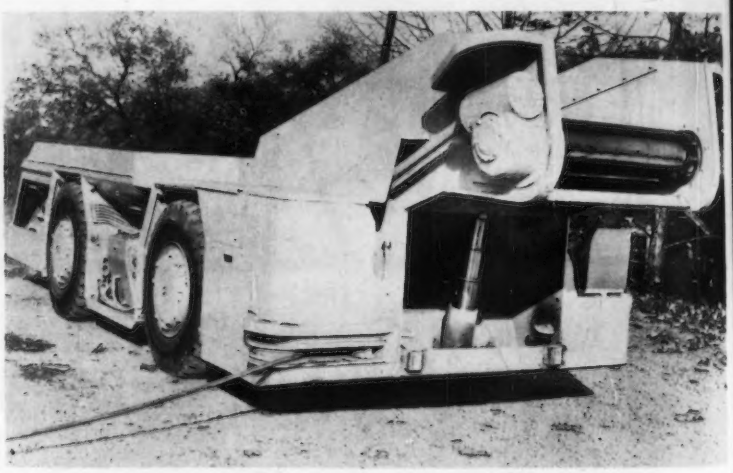
prolonged accuracy

GRIZZLY ROD WITH SKID ROD
ruggedest accuracy

BIXBY-ZIMMER
ENGINEERING COMPANY
527 Abingdon Street, Galesburg, Illinois

Off-Road Transporter Truck Will Haul 70,000 lb (19)

Steep embankments can be taken in stride with 70,000-lb load with this R. G. LeTourneau, Inc. all-wheel drive truck called the Transporter. Unit has scraper blade and brush cutter attached and is intended for work in rough terrain.



Shuttle Car Is 48-in. High, Uses Only One Motor (20)

National Mine Service Co. says that this shuttle car operates all four wheels, raises and lowers the boom, runs cable reel, steering mechanism and drives the conveyor from a single ac or dc motor. Unit is used in coal mines.

Semi-Automatic Welder (16)

Stoody Co. offers a semi-automatic unit that feeds welding wire (not rod) from reel attached to rig. Welder can deposit up to 20 lb metal per hour.

Looking For a Casting Alloy? (18)

Better check on American Steel Foundries' Wearpact casting alloy in specifying your next alloy on mill liners, mining and material-handling equipment.

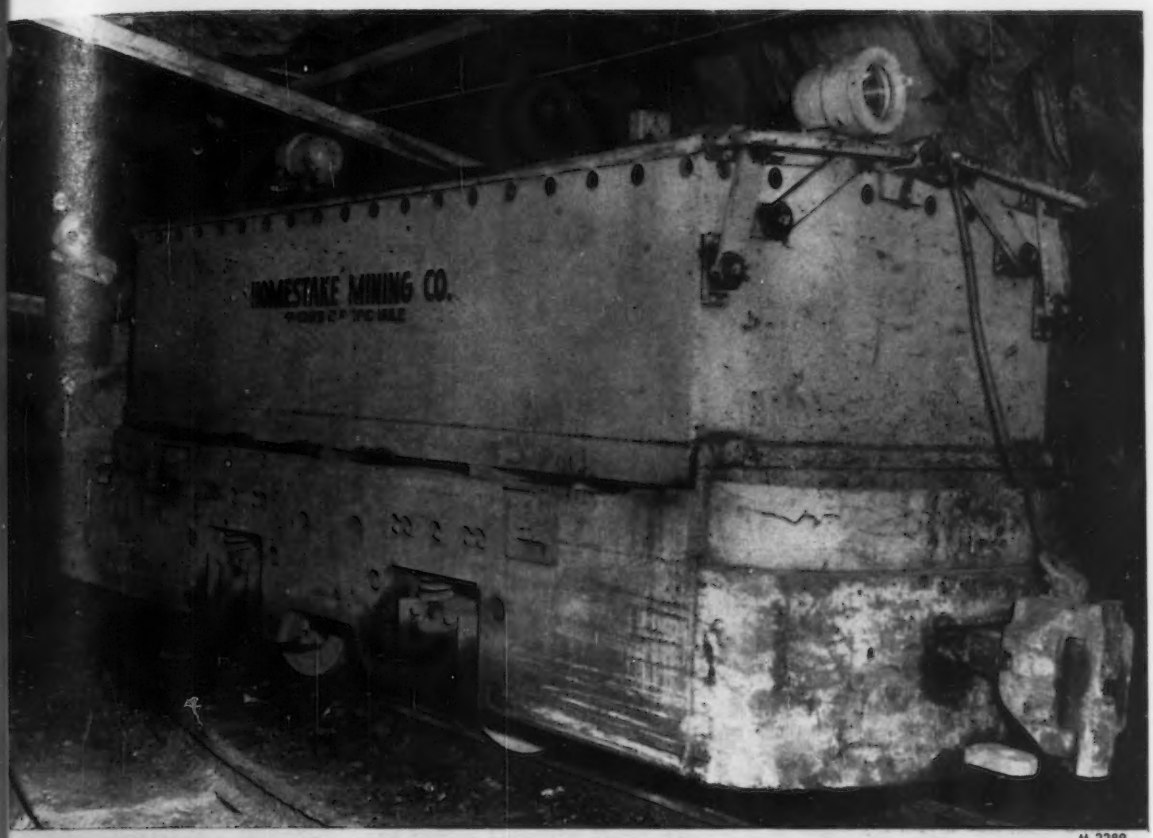
Electrical Cable (17)

Two new types of USE, Style RR, nonmetallic, neoprene-covered, 600v cables are available under Bronco label from Western Insulated Wire Co. Sizes offered run from 18 through 24.

Flareless Tube Tool (24)

Device fits into vise to hold tube, while operator uses wrench to pre-set ferrule onto tube, according to Parker Appliance Co.

Continued on page 40. For more information on items, use card opposite page 42.



M-2289

MANCHA Solves Another Haulage Problem

MINE HAULAGE DATA:

Track Gauge	18"
Min. curve radius	25'
Grade	Level to .25%
Condition of track	Occasionally very slippery due to coating of slimes on rail from back filling operation.
Length of haul	2500 ft. from loading chute to shaft pocket.
Car Specifications Design	Granby type
Tare	2.15 tons
Capacity	3.6 tons
Size trip	20 cars
Tonnage desired	1000 tons in two haulage shifts.

LOCOMOTIVE DESIGN REQUIREMENTS:

Short wheel base for negotiating sharp radius curves. Length, width and height dimensions to suit mine cage, dumping ramp, and chute lip location.

Running speeds of 7-9 mph, loaded and empty trips. Ability to start loaded trips on curves and against grades with slippery rail conditions.

SOLUTION:

Mancha Hercules BX Storage Battery Locomotive—8½ ton operating weight with 2 motors for a total of 54 hp at 108 volts.

PERFORMANCE:

This Mancha locomotive has met all dimension limitations. It has pulled 25 loaded cars in one trip. It has hauled 650 tons in one shift and 1000 tons in two shifts. It has solved the problem of starting and accelerating on slippery rails by direct connection between axles plus sanders in front of leading wheels in each direction. And it has provided these additional design advantages: (1) safety for the motorman through hand operated hydraulic brakes for quick, positive braking; a deadman foot switch; heavy protective plate around cab. (2) mechanically cam-operated, heavy-duty controller with main line contacter to prevent dragging controller points and to reduce contact wear.

RESULTS:

Ten Mancha Hercules BX locomotives are currently in use at the Lead, South Dakota operation of the Homestake Mining Company.

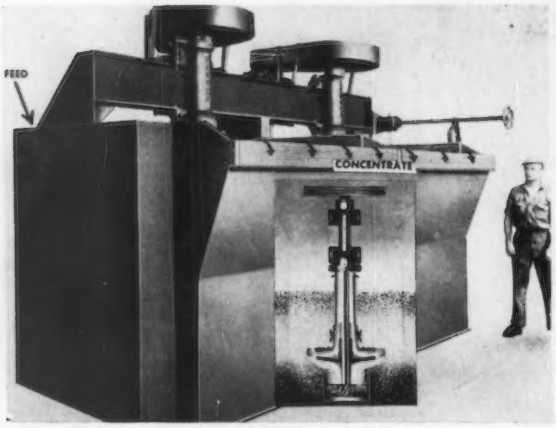
There is a Mancha locomotive to do a profitable job in your mine. Let us analyze your requirements and make a recommendation. There's no obligation on your part.

MANCHA STORAGE BATTERY LOCOMOTIVE

DIVISION GOODMAN MANUFACTURING COMPANY

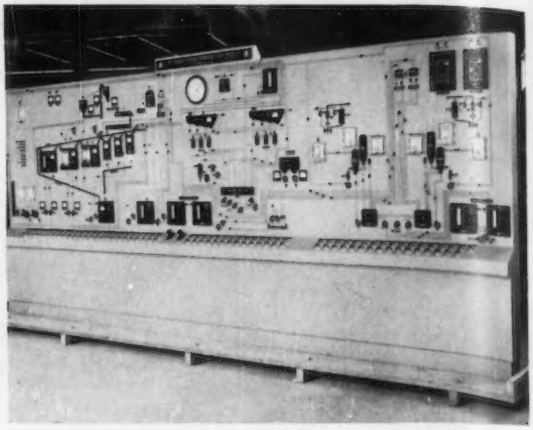
Halsted Street and 48th Place • Chicago 9, Illinois • Cable Address: Mancha, Chicago

Mancha representatives are located in principal mining areas throughout the world.



Denver Type-M Flotation Machine (21)

Big machine for big tonnage flotation, according to Denver Equipment Co., through improved sub-aeration method that dissolves more air under pressure (to promote nascent air) and has improved high-velocity agitation. Size is available in 2 and 4 cell units, with 200 cu ft capacity per cell.



Dorr-Oliver Flowsheet Instrument Panel (22)

Instrument was designed for Norwegian phosphate fertilizer producer with plant flowsheet laid out on the panel in silhouettes of operating equipment cut to both scale and shape. Where possible, switches, information and controls are located entirely inside the cut-outs.

Centrifugal Pressure Pump (25)

Self-priming, single-cylinder, two-cycle, air-cooled, gasoline-driven Model 24S3-1P, by Homelite, can deliver up to 205 gpm at open discharge and 55 gpm at 70 psi. It has suction lift of 28 ft and total head of 185, including friction; and comes equipped with 3-in. fittings on inlet and outlet.

Balanced-Weight Feeder (26)

Balanced weights that can be preset to release any desired quantity from 200 to 2,000 lb per hour operate this unit. Automatic start and stop to synchronize with other equipment can be added, according to Wallace & Tiernan Inc.

Roll Pulverizer Has Classifier (27)

Designed for coal, limestone, gypsum and other industrial materials by Foster Wheeler Corp., this unit combines planetary rolls, table pulverizer and air classifier in one machine.

To Pump Hot Chemicals (28)

Jacketed, steam-heated pump introduced by Nagle Pumps, Inc. will hold molten sulphur and other critical-temperature materials at any desired point.

Temperature Regulator (29)

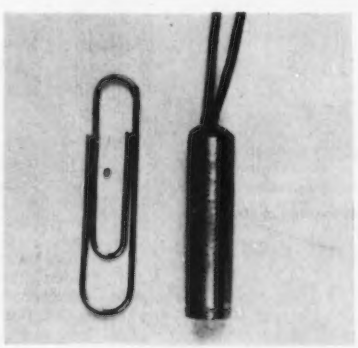
Robertshaw-Fulton Controls Co. says this instrument is designed to withstand corrosive fumes, gases, acids and other chemicals. Made of stainless steel, unit is available in sizes from ½- to 4-in. length, in temperature ranges from 20 to 455 deg F.

Fine Crusher (30)

Traylor Type-TF, fine crushing unit is available in four sizes and designed to break to the 5/16- to 1¼-in. range.

Lightweight Fluorimeter (52)

Mt. Sopris Model FL-210 is intended for analysing uranium minerals and for use in geophysical prospecting, both in laboratory and in the field.



Small Temperature Switch (23)

No bigger than a paper clip, this instrument by Scaico Controls Inc. is available in three temperature ranges, spread over 50 to 275 deg F temperature scale.

Kiln Chains (57)

Thermopruf chain system for wet process kilns offers greater savings than ever thought possible. Chains can be made to suit any length, according to Allis-Chalmers Mfg. Co.

Wobbling Scalping-Feeder (53)

Patented Wobbler feeder is being used in coal, iron ore, gravel and other minerals, according to Universal Engineering Corp. Elliptical bars are set at proper angle and rotate in unison to provide forward motion to feed and pass fines through openings produced during rotation.

For Precise Size Analysis (54)

Sharples Corp. designed the Micromerograph particle distribution analyzer to take the guesswork out of laboratory determinations. Instrument records time and weight of a given particle size as it falls down loading chamber to a balance pan below. Data is recorded on chart so that size percentages can be picked off with template. Sharples will analyze your samples or sell you the equipment.

Stop Rusting New Pipe (55)

Economical way to protect pipe and tubing from contamination and corrosion during storage is to use slip-over and roll-on end caps made of neoprene, according to E. I. du Pont de Nemours & Co., Inc. In addition, a small amount of dehydrating agent is suggested, so that the pipe remains dry.

Speed Starter (56)

A European device to provide quicker starting for gasoline and diesel engines is now available in the U. S. The Wilco Co., Los Angeles, and the Start Pilot Corp., Mineola, N. Y., distribute the attachment that injects a spray of ignition-promoting fluid into the intake manifold, keeps the engine firing until regular fuel source can keep up combustion.

Continued opposite page 42. For more information use card opposite page 42.

E&MJ NEW PRODUCTS DIGEST (*Continued*)

VACUUM PUMPS. For vacuum melting, heat treating, dewatering purposes, NRC Equipment Corp. has developed this Series 4700 Mechanical Booster Vacuum Pumps that can reduce the process time, cut lost production and work steadily in the 5- to 2200-micron range. Six sizes available from 1,000 to 12,000 cfm. **(31)**

QUICKSETTING CEMENT in a can that is reputed to set anchor bolts in 10 minutes is available from Monroe Co., Inc. Material is available in cans, pails and drums and can also be used to patch small holes in concrete. **(32)**

DIESEL WRECKERS and combination wrecker, pile driver and bridge cranes in Orton Crane & Shovel Co. line, range in sizes from 75 tons to 250. Orton says that its units are rail-mounted, offer air conditioned cab and two-way radio. **(33)**

TRACTO-LOADER, TL-20, will make its debut at the ARBA Road Show late this month. According to Tractomotive Corp., this new model has 2-cu yd front-end shovel and is equipped with torque converter. **(34)**

CRAWLER-LOADER with ⅝-cu yd (struck) shovel capacity, constructed so as to take a backhoe, is the latest addition to John Deere Industrial Div. line. Tractor has 30-hp engine. **(35)**

BRAKEMOTORS made of cast iron that stop instantly and hold heavy loads with dead-man unit, are available from Reliance Electric & Engineering Co. Several different enclosures are available. **(36)**

FLASHLIGHT BATTERY developed for general use by Bright Star Industries, has steel reinforced top and bottom to insure against leakage and polyethylene inner barrier to prevent power dissipation. **(37)**

TORQUE CONVERTER transmission added to any dipper shovel can reduce strain, get more work done, according to National Supply Co. **(38)**

GRAB BUCKET link-type hinge alignment device developed by Mead-Morrison Div., McKiernan-Terry Corp., eliminates jamming and breakdowns common to gear-type devices, according to company. **(40)**

TWO-SPEED ELECTRIC HOIST, equipped with fractional hp 1800/450 rpm motors provide fast lifting and lowering speed as well as slow, ¼ normal speed for gentle positioning work. Wright Hoist Div., American Chain & Cable Co. **(41)**

VACUUM CLEANER offered by Va-U-Max Sales Co., can pick up any solid that will pass through hose. Unit is available in 30- and 55-gal capacities, wet and/or dry use. Operates on compressed air, at 16-in. mercury. **(42)**

LOADING SHOVEL that can discharge at a height of just over 16 ft is being manufactured in England by F. E. Weatherhill & Co. Capacity is 1500 lb. **(43)**

GAS-DRIVEN ROCK DRILL recently demonstrated in London by Atlas Copco (Great Britain) is called the Cobra, weighs 53 lb, will drill to 13 ft. **(44)**

TRACTOR-MOUNTED RIPPERS, designed for speeding bulldozing work, have been announced in two new sizes by Caterpillar Tractor Co. Rippers are hydraulically operated. **(45)**

VARIDYNE POWER UNIT with drive motor and alternator on same side, for limited-space installations, has been added to U. S. Electrical Motors Inc. line of equipment. Ideal for conveyors and multiple drive operations. **(46)**

SCINTILLOMETER reportedly can detect plus or minus changes of 0.0005 to 0.003% U_3O_8. A scintillometer developed by Edison Swan Electric Co., Ltd., is claimed to have a lower relative background than Geiger-Muller. **(39)**

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card at right and mail.

CORE DRILLING units available from Sprague & Henwood Inc., are described in 8-p bulletin now available from company. **(47)**

MOLY-SULPHIDE LUBRICANTS technical data are provided in Climax Molybdenum Co.'s 12-p release, covering field and laboratory tests. **(48)**

STATIONARY DIESELS, developed and offered by White Motor Co., are described in illustrated bulletin, showing performance curves, and horsepower ranges available. **(49)**

REFRACTORIES is the name of a bi-monthly bulletin published by Carborundum Co. October issue, No. 5, discusses transverse load tests and offers excellent tables on test results with many types of refractory material. **(51)**

FEB. 1956

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5	19	33	47	61	75	8
6	20	34	48	62	76	9
7	21	35	49	63	77	9
8	22	36	50	64	78	9
9	23	37	51	65	79	9
10	24	38	52	66	80	9
11	25	39	53	67	81	9
12	26	40	54	68	82	9
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4	18	32	46	60	74	88
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6	20	34	48	62	76	90
7	21	35	49	63	77	91
8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	52	66	80	94
11	25	39	53	67	81	95
12	26	40	54	68	82	96
13	27	41	55	69	83	97
14	28	42	56	70	84	98

Name .....

Title .....

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E&MJ NEW PRODUCTS DIGEST (*Continued*)

DIESEL AND DUAFUEL ENGINES, Nordberg Mfg. Co.'s type TS-21, can be investigated by getting hold of their 20-p, color bulletin 245. Work shows cross-section, diagrams and photos of important features of this engine. **(66)**

HYDRAULIC FLUIDS that have outstanding corrosion and wear-resistance are described in 16-p booklet. Ucon Hydrolubes are water-based and fire-resistant fluids manufactured by Carbide & Carbon Chemicals Co. **(67)**

STAINLESS STEEL SCREENS for heavy-duty sizing and conveying equipment are covered in 28-p book recently published by Bixby-Zimmer Engineering Co. **(68)**

PORTABLE DUAL-CRUSHING PLANT, offered in four sizes, is introduced in 6-p bulletin from Lippman Engineering Works, Inc. **(69)**

LABORATORY SUPPLIES in plastics are detailed as to appearance, sizes and costs in 15-p catalog from Palo Laboratory Supplies Inc. **(70)**

FASTENERS, drills and drilling devices for construction work are presented in 57-p catalog available from Star Expansion, Inc. **(71)**

OPERATOR'S GUIDE, Caterpillar Tractor Co.'s manual on how to operate Caterpillar equipment to best advantage, gives you step-by-step instructions on their equipment. Latest release covers wheel tractor and scraper. **(72)**

MOTORS, dripproof and enclosed in the 1- to 5-hp range, are the subject of General Electric Co.'s 12-p bulletin, GEA-5980. Publication explains how Tri/Clad motors are constructed to last. **(73)**

PRECISION LAPPING technology is thoroughly covered in 28-p color bulletin offered by Penn Scientific Products Co. Manual details proper use of diamond and silicon carbide abrasives to surface tools, dies, gages and precision wear-parts. **(74)**

BOILER FEEDWATER TREATMENT with Scav-Ox, 35% hydrazine solution, is discussed in detail in 16-p illustrated bulletin available from Industrial Chemicals Div., Olin Mathieson Chemical Corp. Removing O_2 from feedwater is an important step in proper boiler operation. **(75)**

ANALYZE ALMOST ANYTHING ACCURATELY is the title of Podbielniak, Inc., bulletin on their analytical distillation and vapor-phase chromatographic apparatus for rapid analysis of gases. **(76)**

DUST-FREE AIR for laboratories and process air are subject of bulletin offered by Wheelabrator Corp., describing their cloth-arrester dust collecting equipment. Bulletin 557-D. **(77)**

DRY GRINDING MILLS in the Hardinge Co., Inc., line are discussed as to proper application of conical, tricone, cascade, rod, tube, disk mills and air classifiers for dry grinding. Tables, diagrams and performance data are included. **(78)**

CONTROL TRANSFORMERS are detailed in 32-p, two-color publication, GED 2767A, produced by General Electric Co., giving voltage ratings, frequency, frame size, weight, application, price and specification data on autotransformers, control panels and machine-tool transformers. **(79)**

GRINDING MILLS for efficiency and low-cost processing are examined in Nordberg Mfg. Co.'s 9-p, color bulletin 232. Their line of rod, ball, tube, pebble and compartment mills are shown. **(80)**

BIG CATERPILLAR TRACTORS design and construction features are set down in a 12-p illustrated booklet called Big Tracks, issued by Caterpillar Tractor Co. Available in Spanish, French, Portuguese and English. **(81)**

NITROGEN CHEMICALS, their uses, physical and chemical properties, specifications, shipping methods, handling and storage advice and technical services available from Nitrogen Div., Allied Chemical & Dye Corp., are described in 68-p book. **(82)**

DRILL SUPPLIES for soil sampling tools, augers, diamond and shot core drills, earth boring rigs and accessories are fully described in 40-p bulletin from Acker Drill Co. **(83)**

INFRARED ANALYZERS for monitoring furnace atmospheres for CO, CO_2 or CH_4 content are discussed in 4-p folder from Leeds & Northrup Co. **(84)**

UNPLASTICIZED POLYVINYL CHLORIDE pipe, fittings and valves data are presented in 16-p engineering catalog published by Colonial Plastics Mfg. Co. **(85)**

ELECTRONIC WEIGHING and conveying of bulk materials is possible with Electro-Way, according to Bell Automation Corp. Check number for further information. **(86)**

REFRACTORIES covering 19 brands in the Richard C. Remmey Son Co. line are described in 2-color 8-p condensed catalog. **(87)**

HOW THE OIL INDUSTRY GETS THE JOB DONE is the thesis of Gulf Oil Corp.'s 32-p booklet entitled The Industry Nobody Really Knows, by Craig Thompson. **(88)**

CIRCUIT BREAKERS co-ordinated with current-limiting fuses and recommended applications is the subject of General Electric Co.'s 8-p bulletin. Includes tables, showing fuses and their specifications. **(89)**

PLASTIC PIPE bulletin, covering technical properties, sizes and dimensions of American Hard Rubber Co.'s Ace Riviclor, is 8 pages long. **(90)**

ENGINEERING AND MINING JOURNAL

FEBRUARY 1957

Changing Patterns in Mining

As we read the outlook articles in this issue and then try to integrate the many news items, annual reports, speeches and technical stories pertaining to mining published during 1956, we find that many traditional industry patterns are being changed. Here are some of the significant trends:

1. More long-range forecasts. Perhaps the Paley Report stimulated greater interest in the future requirements for metals and minerals. At least, it would seem so because we now find more industry leaders willing to make predictions looking ahead 5, 10 and even 20 years. Note for instance the chart on iron ore requirements by Verne Johnson p 88, and the long-range forecast for aluminum by Irving Lipkowitz on p 96. Other recent forecasts looking well ahead have been made by Roy H. Glover of Anaconda, Robert Koenig of Cerro de Pasco, Jean Vuillequez of American Metals, Sir Ronald Prain of Rhodesian Selection Trust, and William Shea of C. Tennant Sons & Co. The reason for these forecasts is quite obvious. With increasing population and higher per-capita consumption, the mining industry has to anticipate demands by five years to a decade. It takes that long to explore, finance and develop many large mineral deposits.

2. Companies are preparing to meet these demands. An *E&MJ* Research Department survey of new projects and major expansion programs publicly announced during 1956 tallied up some 227 foreign and domestic projects. Out of these, 92 reported planned investments totalling more than $1.9-billion. The other 135 did not report cost estimates. Typical of this long range planning is Anaconda's recent announcement to spend $350-million on expansion programs between 1956 and 1961. About 67% will go into properties in the U. S. and Canada, the balance into properties in Mexico and Chile.

3. New sources of capital. Uranium created more than a temporary boom in mining. It attracted many non-mining companies into the field, and this trend is more pronounced than ever. Companies which formerly confined their activities to the railroading, chemical, oil and gas, or construction industries are now participating in mining ventures on an unprecedented scale. We also note an increasing number of mining companies going into the metals fabrication field to diversify activities.

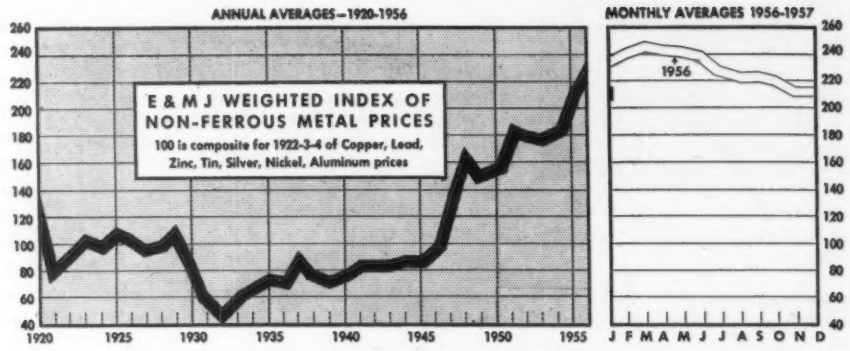
4. Better industrial statesmanship. Mining companies operating in foreign lands are strengthening their public relations programs. Objectives are to explain company policies and plans to the citizens, overcome language barriers, and show how mining enterprises benefit the individual, the community and the nation. This kind of "industrial statesmanship" is going far to eliminate some of the misunderstandings that arose in the past when public relations was ignored.

5. Low cost metals may not always be best for the consumer. Several company presidents have advanced the sound argument, that it's not always to the consumer's benefit to keep metal costs at rock bottom. Expansion programs must be planned to prevent shortages and run-away metal prices which tax the consumer heavily. Consequently a few more cents per pound charged today may save the consumer many cents per pound tomorrow, assuming of course that the current increases are set aside for expansion. See *E&MJ* October 1956 p 67.

6. We're in a technological renaissance. There was a time in the field of mining, milling, and smelting when technologic progress was slow and things remained relatively unchanged from year to year. But since World War II the rate of advance has accelerated tremendously. It's safe to say that more progress has been made in the past 10 years than in the previous 50—and we're only getting off to a good start. With the new electronic computers, modern research tools, brain-storming engineers, and bigger research budgets, the obsolescence rate of traditional technologic methods and processes is bound to be painfully high.

E&MJ OUTLOOK

PRICES



MARKETS

Lower copper and tin prices depressed *E&MJ*'s price index from 216.25 to 215.68 during January.

Selenium supplies are becoming more plentiful. Last month's price drop of $3 per lb for high purity metal signalled the trend.

●

AT HOME

Designers are thinking about using beryllium metal for plane construction. If this idea materializes, weight savings would justify fantastic prices for the metal.

Texas Gulf Sulphur and International Nickel are working on a process to extract elemental sulphur from SO_2. A 10-ton pilot plant will be installed near Inco's iron-production plant near Sudbury, Ontario.

Vitro's new pilot plant will open the door to recovery of millions of tons of manganese from huge domestic manganese silicate deposits. The new process could make the U. S. independent of foreign sources in case of war.

Unconfirmed reports say that Stauffer Chemical Co. is developing a new process which breaks down titanium trichloride to form titanium metal and titanium tetrachloride.

Bunker Hill is recruiting design engineers and chemists from Hungarian refugees at Camp Kilmer, N. J. to work on the $15-million expansion program.

U. S. and Great Britain are exchanging unclassified research data in an effort to slow down the hydrogen-bomb reaction to produce industrial power.

Lake Carrier's Association, Ohio, Wisconsin, Pennsylvania and Canada are putting on a determined fight to prevent the diversion of an additional 7,000 cu ft of water per second into the Illinois Waterway. Present diversion is 1500 cu ft per second. Estimates indicate lowered lake levels would cut seasonal cargo capacity by 10-million tons.

●

LABOR

Clean-up of labor racketeering is almost assured now that it is under a three-pronged attack involving Justice Department investigations, Congressional hearings and the AFL-CIO determination to do a house-cleaning job. The number of unions under scrutiny is small—only about a dozen out of some 250. See complete details p 165.

●

ABROAD

A $2-million geological and geophysical survey in Sicily has revealed 38 sulphur-bearing basins and a large deposit of potash salts.

Exploration at the Buller Gorge uranium strike in New Zealand indicates that the island will have a sizeable uranium mining industry. Ore assays ran as high as 1% U_3O_8.

Watch for exciting new mining developments in the Caribbeans where interest in laterite exploitation is increasing, and other hard-rock mines are under development. See late news page 73 for other Western Hemisphere booming areas.

U. S. Copper Producers Cut Price 2c Lead and Zinc Bartering Began Again

INDUSTRIAL PRODUCTION in January was maintained at about the December level of 147% of the 1947-'49 average. These are based on the Federal Reserve production index.

Nonferrous metal prices dropped further in January. The *E&MJ* average for January is 215.68% of the 1924-'26 average; the December figure was 216.27. This decrease resulted from the drop in copper and tin prices and more than offset the rise in the average price of nickel. Doubtless the average will be down more in February owing to the 2c cut in copper prices effective Feb. 1 by U. S. producers.

Phelps Dodge announced that effective Feb. 1 its refined copper would be sold at 34c delivered in the U. S. International Nickel announced for the same date its price delivered to Canadian buyers would be 32½c; at the existing exchange rate this is about 34c U. S. Kennecott reduced to 34c effective Feb. 1. Annaconda and other U. S. producers will be at the same price on the same date or shortly after.

Custom smelters will sell at well under the 34c price. Dealers on Feb. 1 were willing to sell in the U. S. at 32½–32¾c delivered. No. 2 copper scrap buying price of custom smelters was about 25¾c a lb.

The Rhodesian Selection Trust companies reduced their price to £250 per long ton effective Feb. 1. This is about 31¼c per lb.

Many sellers as well as buyers believe there is nothing to hold prices at these levels; some are openly predicting further price cuts. However, it is reasonable to suppose there will be reductions in output in addition to those announced by Phelps Dodge and Anaconda two or three months ago. It is possible such cuts could be sufficient to get output to less than consumption by fabricators. But unless these cuts have already been in effect, their impact on the output of refined copper will not occur immediately. Some observers believe the important factor is the 437,187 tons held in stock by U. S. fabricators. Only about 18 months ago they had 304,000 tons. On a falling market many fabricators reduce stocks.

Copper fabricating problems are partly disclosed by Federal Reserve Board data. In 1956, output in the U. S. of consumer durable goods was 131% of the 1947-'49 average but in 1955 it was 147%; there was a drop of more than 10%. The drop in automobile output was closer to 25%. Farm machinery output is down. Currently major appliance output is 10 to 20% under a year ago. The value of construction contracts has been well under those of a year ago. Residential is down more than other building contracts but the later is down by about 15%.

Copper and Brass mill shipment data in million of lb, for 1955 and 1956, released by the American Bureau of Metal Statistics, follow:

Copper

	Sheet	Wire	Rod	Pipe, tube	Total
1955	273	6	72	468	819
1956	225	9	88	418	740

Brass and other Alloys

1955	614	105	589	162	1,470
1956	526	88	488	159	1,261

Lead markets have held more firmly than the other nonferrous metals. Early in December the British Board of Trade announced it would sell lead and zinc from its stockpile—in January it indicated it would sell 30,000 tons of lead over the period March-December 1957. Most of this will be available to the original sellers. Current market prices will determine the prices at which the lead will be sold.

GSA asked for tenders of lead in January; most observers think it took a little less than in December. The U. S. Commodity Credit again came into the market for lead and zinc in the barter program.

American Bureau of Metal Statistics data for December show shipments to domestic industry were 44,191 tons and shipments to other buyers in the U. S. were 5,882 tons. Both figures are down from November. Sales reported to *E&MJ* for January suggest slightly higher sales and shipments than in December.

Zinc prices here remained firm owing to continued Government buying. Most observers think GSA took less zinc this month than last. Also, some believe it wanted a larger proportion of High Grade relative to Prime Western. U. S. production of slab zinc reached a record in December. The strike at the AS&R Corpus Christie plant—it produces Special High Grade—ended Jan. 14.

Data on U. S. zinc shipments by grade, in short tons from American Zinc Institute statistics (including shipments to U. S. Government) follow:

	1955	1956	Dec. 1956
Special High	402,629	343,350	33,219
High Grade	145,150	141,883	14,663
Intermediate	23,543	24,770	4,067
Prime Western, etc.	542,787	524,524	47,838
Total	1,114,109	1,034,527	99,787
Shipments to U. S. Government	(87,200)	(157,015)	(18,354)

Aluminum markets have eased considerably. Early in the month there were reports some of the primary producers would attempt to put large amounts to the Government this year. Alcoa denied it would. Later in the month power shortages were reported to have led to considerable reduction in output, especially in the Northwest. Apparenlty all or most of the "interruptible" power has been cut off. There is no evidence that the weak market situation has caused the companies to cut back more than they otherwise would. The production reductions may decrease the need to put metal to the Government. There are reports some fabricators who had purchased domestic primary aluminum have resold it at discounts to dealers. These in turn are offering it on the market.

Government purchases of domestic minerals may not be continued. Funds for tungsten and other minerals had run out. But the President asked for $30-million and indicated he would ask later for another $40-million. This will make up the $91-million originally sought to purchase domestic tungsten ores, asbestos, acid grade flourspar and columbium-tantalum. But a sub-committee of the House Appropriations Committee rejected the request, apparently objecting to subsidizing products for which there appears to be a great surplus. But the full committee may reject the sub-committee view.

Copper Institute Data

United States

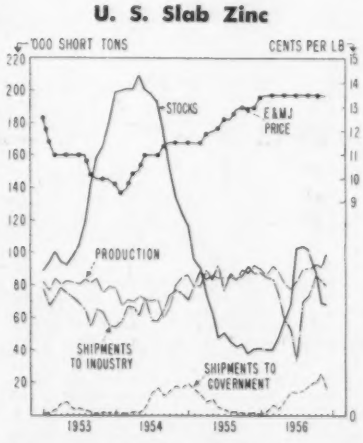
Production:	1955	1956
Crude, primary	1,036,702	(a)1,131,812
Crude, secondary	124,760	139,412
Total	1,161,462	(a)1,271,224
Refined copper	1,467,448	1,580,287
Deliveries, refined	1,446,354	1,465,899
Stock at end, ref'd	61,554	120,645

Outside United States

Production:		
Crude, primary	1,576,960	1,729,611
Crude, secondary	8,305	12,952
Total	1,585,265	1,742,563
Refined copper	1,260,861	1,406,459
Deliveries, refined	1,298,037	1,365,008
Stock at end, ref'd	159,777	232,961

(a) Corrected.

U. S. Slab Zinc



Data, except price, from American Zinc Institute. They refer to slab zinc from all U. S. primary and secondary smelters. Output from foreign ores included. Price is the E&MJ weighted average St. Louis price. December the last month reported.

MARKETS (*Continued*)

Average Prices January (*E&MJ* Quotations)

Copper:	
Electrolytic, domestic refinery	35.526
Electrolytic, export refinery	33.337
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and sterling exchange:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz.	80.290
Sterling Exchange, "Checks"	279.570
Zinc:	
Prime Western, East St. Louis	13.500
Prime, Western, delivered (g)	14.000
Tin:	
New York Straits	101.308
Gold, per oz. U. S. price	$35.000
Quicksilver, per flask	$255.000
Antimony, (*E&MJ*) (d)	36.590
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$101.038
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	27.100
Magnesium, ingot	35.250
Nickel (f)	74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotation.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(e) Tin content.

(f) Contract price, f.o.b. Port Colborne, U.S. duty included. Other regular sellers 78¼¢ to $1.25.

(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

January international gold transactions declined 14%. Bar prices were below $35 in London, Zurich, Tangier and Mexico City; Karachi listed a new high for bars. Coin prices dropped fractionally in most markets but averaged 27% above bars. The Soviets sold $18-million of gold in Zurich. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Dec. 31	Jan. 31	Dec. 31	Jan. 31
NEW YORK, transit	.....	.....	$35.08	$35.08
MANILA	$44.00	$43.90	36.25	36.20
HONG KONG	42.50	42.75	37.80	38.70
BOMBAY	54.75	55.00	54.25	56.60
TANGIER	42.75	42.40	34.92	34.90
BEYROUTH	45.15	45.05	35.10	35.07
PARIS	46.00	46.05	36.15	35.85
BUENOS AIRES	39.25	39.50	36.10	35.65

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Jan. 1957	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	Holiday							
2	35.575	33.450	16.000	15.800	14.000	13.500	25.000	99.500
3	35.575	33.550	16.000	15.800	14.000	13.500	25.000	99.500
4	35.550	33.275	16.000	15.800	14.000	13.500	25.000	99.875
5	No Market	33.275	16.000	15.800	14.000	13.500	25.000	99.875
7	35.600	33.775	16.000	15.800	14.000	13.500	25.000	99.500
8	35.575	33.625	16.000	15.800	14.000	13.500	25.000	99.500
9	35.525	33.575	16.000	15.800	14.000	13.500	25.000	100.500
10	35.550	33.750	16.000	15.800	14.000	13.500	25.000	100.875
11	35.550	33.775	16.000	15.800	14.000	13.500	25.000	100.750
12	No Market	33.775	16.000	15.800	14.000	13.500	25.000	100.750
14	35.400	33.375	16.000	15.800	14.000	13.500	25.000	100.750
15	35.575	33.600	16.000	15.800	14.000	13.500	25.000	102.000
16	35.550	33.700	16.000	15.800	14.000	13.500	25.000	101.875
17	35.575	33.825	16.000	15.800	14.000	13.500	25.000	101.750
18	35.475	33.550	16.000	15.800	14.000	13.500	25.000	101.250
19	No Market	33.550	16.000	15.800	14.000	13.500	25.000	101.250
21	35.575	33.225	16.000	15.800	14.000	13.500	25.000	101.750
22	35.425	33.350	16.000	15.800	14.000	13.500	25.000	102.375
23	35.400	32.900	16.000	15.800	14.000	13.500	25.000	102.500
24	35.600	32.750	16.000	15.800	14.000	13.500	25.000	102.500
25	35.575	32.750	16.000	15.800	14.000	13.500	25.000	102.375
26	No Market	32.750	16.000	15.800	14.000	13.500	25.000	102.375
28	35.375	32.775	16.000	15.800	14.000	13.500	25.000	102.250
29	35.475	33.100	16.000	15.800	14.000	13.500	25.000	102.625
30	35.500	33.200	16.000	15.800	14.000	13.500	25.000	102.750
31	35.575	32.525	16.000	15.800	14.000	13.500	25.000	103.000
AVERAGES FOR MONTH								
Jan.	35.526	33.337	16.000	15.800	14.000	13.500	25.000	101.308
AVERAGES FOR WEEK								
Jan.								
2	35.600	33.390	16.000	15.800	14.000	13.500	25.000	100.325
9	35.565	33.513	16.000	15.800	14.000	13.500	25.000	99.792
16	35.525	33.663	16.000	15.800	14.000	13.500	25.000	101.167
23	35.490	33.400	16.000	15.800	14.000	13.500	25.000	101.813
30	35.505	32.888	16.000	15.800	14.000	13.500	25.000	102.479
CALENDAR WEEK AVERAGES								
Jan.								
5	35.594	33.375	16.000	15.800	14.000	13.500	25.000	99.725
12	35.560	33.713	16.000	15.800	14.000	13.500	25.000	100.313
19	35.515	33.600	16.000	15.800	14.000	13.500	25.000	101.479
26	35.515	32.954	16.000	15.800	14.000	13.500	25.000	102.313

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Jan. 1957	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
1	Holiday				
2	91.375	79.875d.	278.7500	250s. 7d.	$35.00
3	91.375	80.000d.	278.8705	250s. 5¾d.	35.00
4	91.375	80.000d.	278.9910	250s. 4½d.	35.00
5	(e)	(e)	(e)	(e)	35.00
7	91.375	80.250d.	279.3125	250s. ¾d.	35.00
8	91.375	80.500d.	279.2366	249s. 11¾d.	35.00
9	91.375	80.500d.	279.2455	250s. 0d.	35.00
10	91.375	80.500d.	279.3750	249s. 11¾d.	35.00
11	91.375	80.500d.	279.6614	249s. 9d.	35.00
12	(e)	(e)	(e)	(e)	35.00
14	91.375	80.500d.	279.7500	249s. 6¼d.	35.00
15	91.375	80.500d.	279.8072	249s. 4½d.	35.00
16	91.375	80.500d.	279.7708	249s. 3½d.	35.00
17	91.375	80.500d.	279.7500	249s. 4¼d.	35.00
18	91.375	80.500d.	279.6875	249s. 3d.	35.00
19	(e)	(e)	(e)	(e)	35.00
21	91.375	80.500d.	279.7500	249s. 2¾d.	35.00
22	91.375	80.500d.	280.0000	248s. 11d.	35.00
23	91.375	80.500d.	279.8958	249s. 0d.	35.00
24	91.375	80.250d.	279.8437	249s. 2d.	35.00
25	91.375	80.000d.	279.7500	249s. 1¾d.	35.00
26	(e)	(e)	(e)	(e)	35.00
28	91.375	80.000d.	279.8125	249s. 2¾d.	35.00
29	91.375	80.000d.	279.7812	249s. 1¾d.	35.00
30	91.375	80.000d.	279.7500	249s. 2¾d.	35.00
31	91.375	80.000d.	279.7500	249s. 3¼d.	35.00
AVERAGES FOR MONTH					
Jan.	91.375	80.290d.	279.570	—	35.00
AVERAGES FOR WEEK					
Jan.					
2	91.375	—	278.664	—	35.00
9	91.375	—	279.131	—	35.00
16	91.375	—	279.673	—	35.00
23	91.375	—	279.817	—	35.00
30	91.375	—	279.787	—	35.00

Calendar Week Averages: New York Silver: Jan. 5th, 91.375; 12th, 91.375; 19th, 91.375; 26th, 91.375.

(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

London Metal Exchange Quotations

Jan.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1								Holiday								
2	266½	267	265½	266	116½	117	114¾	115	101¼	101½	96½	97	776	777½	775	767
3	267½	268	266½	267	118¼	118½	115½	116	101¼	101½	97	97¼	779	780	768	769
4	271	272	269	269½	117¾	118	115½	115¾	102	102¼	97½	97¾	783	784	772	772½
7	269½	270	267½	268	116¾	117	115	115¼	101	101¼	96¾	97	779	780	767	768
8	269	269½	267	268	115½	116	114¼	114¾	101¾	102	97	97¼	779	780	767½	768½
9	272	272½	270	270½	116¼	116½	114¾	115	102¾	103¼	98	98¼	781	782	768	769
10	270	270½	268½	269	116¾	117	115	115½	103¼	103¾	98¼	98½	788	790	776	777
11	266½	267	265½	266	116	116¼	114¼	114½	102¾	102½	97	97½	786	787	775	776
14	270½	271	269½	270	116½	116¾	114¾	115	103	103¼	98	98¼	782	783	769	770
15	270½	271	269½	270	116¾	117¼	115	115¼	105¼	105¾	99	99½	788	789	774	775
16	269½	270	268	268½	116½	116¾	114½	115	103	103½	98½	98¾	790	792	776	777
17	268	268½	267	267½	116½	116¾	114½	114¾	103½	104	99	99¼	787	788	773	774
18	266½	267	266	266½	115¾	116	114	114¼	102¾	103	98½	98¾	782½	785	769	770
21	267	267½	266	266½	116¾	117	114½	114¾	103¼	103½	98¾	99	789	790	770	771
22	265	265½	264½	265	116¼	116½	114¾	114½	103½	104	99¼	99½	797½	799	776	777½
23	263	263½	262	262½	116	116¼	114	114¼	104	104¼	99½	99¾	802	804	775	777
24	262½	263	261½	262	115½	115¾	113¾	114	103¾	104¼	99¼	99¾	795	797½	771	772
25	262½	263	261½	262	115	115¼	113½	113¾	104	104¼	99½	99¾	796	797	772	772½
28	260½	261	259	260	114¼	114¾	113¼	113½	103¾	104	99½	99¾	796	797	767½	768
29	257½	258	256½	257	114¾	115	113¾	114	104½	104¾	100	100¼	799	800	770	771
30	257	257½	256	257	115	115½	114	114¼	104¾	105	100¾	101	796	797	770	771
31	252	252½	251	251½	115	115¼	113¾	114	103½	103¾	100¼	100½	796	797	771	772
Av'g's	£265.898		£264.716		£116.256		£114.534		£103.256		£98.682		£789.159		£771.523	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98¾ and tin min. 99.75%

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. St—short ton, lt—long ton.

MISCELLANEOUS METALS

Jan. 31, 1957

Aluminum ingot, 99 plus % lb.			27.1¢
Antimony, spot, lb. less than carload, in cases			36.59¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb			$2.25
Cadmium, commercial sticks, delivered, lb			$1.70
Calcium, lb, ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb, contract del			$1.29
Cobalt, 97 to 99%, per lb. eff. Dec. 1, 1957 (d)			$2.35
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz			$2.25
Lithium, lb, 98%	$11.00	@	$14.00
Nickel, cathodes, contracts, lb. f.o.b. Port Colborne (a)			74¢
Other sales, reg. sellers	78¼¢	@	$1.345
Sales by dealers, etc			$2.15
Magnesium, 99.8%, carloads, lb, producer's plants, Velasco, Texas, Eff. Apr. 16			35¼¢
Palladium, troy oz	$23.00	@	$24.00
Platinum (wholesale lots) troy oz	$97	@	$101
Quicksilver, flask of 76 lb, 25 flasks or more	$255	@	$257
Selenium, 99 plus %, lb. (Feb. 1) (c)	$13.50	@	$15.50
Silicon, minimum 97%, carloads, lb			20½¢
Semi-Conductor grade, lb			$3.50
Tellurium, lb	$1.50	@	$1.75
Thallium, 100 lb or more, lb			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb			(b)$2.75

(a) Eff. Dec. 6, 1956 Incl. U. S. duty. (b) Effective Dec. 3, '56.
(c) Jan 1, '57 the $15.50 will drop to $12; the "producer" price, now $13.50, will be discontinued. (d) Feb. 1, $2.00.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$38.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$29	@	$29½
48% Cr_2O_3 3 to 1 ratio	$55	@	$61
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.85(c)
Mesabi bessemer			$11.60(c)
Mesabi, non-bessemer			$11.45(c)
Lead (Galena), 80%, Joplin, Mo., ton			$201.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports, import duty extra, export duty included, $1.64 @ $1.69; both duties excluded, $1.505 @ $1.555. Long-term contract nominal.			
Molybdenum Ore, 90%, per lb of Mo f.o.b. mines	$1.18	@	$1.23
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.35	@	$1.40
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$26.25	@	$26.50
U. S. mined concentrate, per stu, f.o.b. mill (GSA price)			$55
Vanadium Ore, per lb of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore. Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal.
(c) Eff. 1957 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb, in bbl carload lots delivered			5½¢
Cobalt Oxide, 72½% to 73½%, per lb. eff. Dec. 1, '57 (a)	$1.78	@	$1.81
Copper Sulphate, 100 lb. eff. Oct. 25, '56			$13.90
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.30	@	$1.33

ALLOYS

Ferrochrome 65]to 70%, per lb of Cr. (4-9% C)			27¾¢
Ferromanganese, 74 to 76%, per lb., shipg. pt			12¾¢
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained	$1.68	@	$1.74
Ferrosilicon, 50% per lb of Si f.o.b. shipping point			13.90¢
Ferrotungsten, 72 to 82%, lb of W contained (eff. Oct. 30)			$3.15
Ferrovanadium, per lb of V delivered	$3.20	@	$3.40
Silicomanganese, max. 1½% carbon, lb, contracts			13.80¢
Spiegeleisen, per long ton, 19 @ 21% grade eff. Jan. 7			$102.50

(a) $152 @ $155, Feb. 1

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b., Vancouver, B. C. (U. S. funds):			
Spinning fiber	$460	@	$750
Shingle fiber, effective Jan. 1	$205	@	$300
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Crude oil well grade, min. 4.3% sp gravity, st (a)			$11.50
Imported, c.i.f. Gulf Ports, st	$16	@	$18
Bauxite, long ton, f.o.b. point of shipment:			
Domestic crude, 50 to 52% (not dried)	(a)$5.00	@	$5.50
Domestic, chemical, 55 to 58%	(a)$8.50	@	$9.05
Domestic, abrasive, 80 to 84%	(a)$18.00	@	$18.50
Imported metallurgical, per lt, fob Br. Guiana, dep. on grade			$7.14
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37	@	$41
60% effective CaF_2	$33	@	$36.50
Acid 97% concentrate, bulk, ton: contract			$52.50
spot			$55
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00

Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.

Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, per lt f.o.b. U. S. mines: bright			$26.50
dark			$25.50
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Nominal. (b) Corrected.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$62.50
Steel f.o.b. Pittsburgh, billets, net ton			$74.00
Structural shapes, Pa., Ala. etc., 100 lb	$4.85	@	$5.00

THIS MONTH IN MINING

New Staking Surge Begins in La Ronge Area

DECISION OF ANGLO-ROUYN MINES late in November to push deep diamond drilling from surface this winter on its Moose Point property off Waden Bay in north-central Saskatchewan is sparking a renewed surge of staking and exploration activity by several mining companies which hold nearby properties with promising copper-nickel mineralization.

Staking in La Ronge area and, specifically, the Churchill mining district, has been highest in more than two years, with about 850 claims a month currently being registered.

Most staking is ranging slightly north and up to 40 miles east of La Ronge itself, in the Drinking-Keg-Trade lakes area and directly north of these lakes at Pitching Lake. Surface exploration here has already outlined a 15-mile mineral belt, mainly chalcopyrite.

Anglo-Rouyn is well into its current program and for next five months will push a surface diamond drilling program to investigate areas below level of the ore already known and assayed.

Company recently completed its underground work. Two-million tons of ore were indicated below surface in addition to outlying tonnages of 1-million ton. Ten crosscuts over a 1,000-ft length opened on 500-ft level showed an average grade of 2.56% Cu and 0.024 oz gold per ton over an average width of 16 ft and 1.92% Cu, 0.01 oz gold over 25 ft.

Indicated tonnage did not justify mining operations, company decided, but was highly promising if deep drilling from surface should reveal additional orebodies of similar grade.

Among companies maintaining activity in Waden Bay area is Jahala Lake Uranium Mines. On one of two properties abutting Anglo-Rouyn this group has located 18 different copper showings in a strike along a 1¾-mile length. Following magnetometer survey and some geophysical work, company has started drilling.

Also adjoining holdings of Anglo-Rouyn is copper prospect of Kaiser Development Corp. About 20 holes are being drilled in current exploration phase, each to a 150-ft minimum. First holes have intersected about 22 ft of mineralization containing chalcopyrite and pyrrhotite.

Eight miles west of Anglo-Rouyn, at Nemeiben Lake, Fano Mining and Explorations has put a second drill to work on a 36-claim nickel-copper prospect and has about 3600 ft of drilling completed. Earlier drilling this summer from surface had indicated large tonnages of low grade material at 500 ft, specifically, 85 ft of mineralized deposits of which 45 ft averaged 1.08% combined nickel-copper. Purpose of present drilling operation is to probe for richer deposits.

This area was worked over several years ago by International Nickel Co. for a total of 5 holes which revealed 35 ft of 1% copper-nickel mineralization. More recently, this company has been active at Forbes Lake, 60 miles northeast of La Ronge.

East and north of La Ronge, sinking of a 2-compartment prospect shaft at Pitching Lake Copper property of Glenn Uranium Mines is completed, and drifting is under way toward the A zone. Although diamond drilling from surface has been suspended, surface stripping is being continued on other adjacent showings by the company.

La Ronge Uranium Mines has 18 copper prospect claims in the Pitching Lake area and has in addition a large low-grade deposit of 0.08% uranium oxide at Nistowiak Lake much farther north. Exploration work on both will be extended as soon as financing can be arranged.

Elsewhere in the La Ronge area:

Madsden Red Lake Gold Mines, with a 26-claim copper group immediately east of Anglo-Rouyn, had some diamond drilling underway during the fall. Several companies were maintaining their standings on claims but awaiting developments on nearby properties. These include Precam Explorations, Tombill Mines, Consolidated Regcourt Mines, Pioneer Contractors, Newmont Mining Corp., Selco Exploration (subsidiary of the Selection Trust Co. of London), Kelkeno Copper, and Forbes Lake Mining Corp.

Ventures Producing Copper At Kilembe

FOLLOWING TEN YEARS of preliminary examination, exploration, mine and mill construction, Kilembe Mines Ltd., Uganda, went onstream last Nov. 24, with official ceremonies presided over by Sir Andrew Cohen, Governor of Uganda. Kilembe represents the first breakthrough of mining in the territory.

Kilembe has a mine, open-pit and underground; 1500-tpd mill and smelter; plus a 208-mile railroad extension from Kampala through the bush to Kilembe. Estimated life of the mine is 22 years, with some 17-million tons, 1.88% Cu and 0.2% Co ore developed to date. In the beginning, the mine will yield 480,000 tons per year, with eventual expansion toward a 720,000-ton capacity.

Frobisher Ltd., controlled by Ventures Ltd., took over concession from Tanganyika Concessions Ltd. in 1947 and began, almost immediately, to prepare the groundwork for Kilembe Mines. With present £8-million layout, Kilembe will produce some 9,000 tons blister a year. On the drawing board is a cobalt refinery scheduled for completion in 1958. At present time concentrate from the mill goes to smelter at Jinja, with cobalt concentrate and blister copper being exported from Mombasa.

Ore occurs in both oxide and sulphide zones. Minerals present include: cuprite, malachite, chrysocolla and chalcocite in the oxide; and chalcopyrite, pyrite and pyrrhotite in sulphide. About 45% of production will come from open pit, with remainder distributed 60-40 between the two underground workings.

Fully staffed, Kilembe will employ some 30 Europeans and over 800 Africans, with mine operating three shifts.

In the mill, ore will be crushed in Pegson 20B coarse crushers, then through secondaries to storage silo. Merrick weightometer delivers crushed ore to Allis-Chalmers 8x8 ball mills, using 3 and 4-in. balls. Mill discharge goes to a 66-in. spiral classifier with oversize returning to mill. Pulp, 50% minus 200 mesh is floated with Xanthate-pine oil in Denver No. 24 Sub-A's.

Rougher concentrate enters thickener and goes to Allis-Chalmers 5x8 ball mill. Regrind is floated in Sub-A's with copper in float and cobalt in underflow. Reagents in regrind circuit are Reagent 208 and pine oil with lime as depressant.

Copper recovery is 90% and cobalt recovery about 85%.

Copper concentrate is dewatered on Oliver 6-ft dia disk filter, then roasted in Dorr FluoSolids roaster at 1400 to 1500 deg F. Roast is blended with fresh concentrate, cooled and shipped to Jinja smelter.

U.S. Steel Plans Move On $200-Million Mine

CARTIER MINING, subsidiary of U. S. Steel Corp., is ready to start this spring on $200-million iron ore mining development north of Shelter Bay, Quebec, according to Premier Maurice Duplessis of Quebec.

The Premier described project, 300 miles northeast of Quebec City, as a "colossal" undertaking. Construction schedule calls for completion of project by 1961.

In Montreal, an official of new U. S. Steel subsidiary told McGraw-Hill World News that Premier's statement was substantially correct.

Spokesman at Mines Department of Quebec said a major aspect of project is construction of large iron ore concentrating plants at the mining site. Plant will produce high-grade iron ore pellets from low-grade deposits with an iron-ore content of about 30%.

Project is largest of its kind since Iron Ore Co. of Canada undertook five years ago, at a cost of $250-million, to mine rich deposits of iron ore straddling Quebec-Newfoundland boundary.

Cartier mining's site is located entirely in Quebec over an area southwest of IOCC's deposits. Claims owned by Car-

tier extend as far north as Mount Wright, 220 air miles north of Shelter Bay.

Mr. Duplessis said a ship-loading center will be established at Shelter Bay, a quiet little village on shores of the St. Lawrence River. Project also calls for a 150-mile railway to the first mining site, 70 miles south of Mount Wright, and a hydroelectric power plant on the Hart Jaune River.

Later, another 100-miles of railway tracks would be laid to a second mining site near Mount Wright. Reserves of low-grade ore were reported to be enormous throughout area.

Mr. Duplessis said Cartier Mining is incorporated in Ontario, and a new company will be incorporated in Quebec to operate the development. Its name will be—Quebec Cartier Mining Co.

Work will start as soon as the snow melts.

Montecatini Aluminum Expands; Potash Studied

SPECIAL MEETING OF SHAREHOLDERS of Montecatini has approved a motion for raising company's capital to 100-billion lire ($160-million) so as to provide part of financial means required for carrying out a program which will include:

A new battery of aluminum furnaces in Bolzano factory with an output potential of 4,000 tons yer year.

Plans are also being made for providing the works at Crotone (Calabria) with new equipment for producing aluminum; the first in South Italy.

Having ascertained that potash beds recently discovered in Sicily are large and that conditions are favorable for working them, a plan has been prepared for production of potash salts refined by an original process studied and worked out Montecatini.

El Sol Gold Studies New Magnetite Deposit

LARGE TONNAGE IRON DEPOSIT is indicated in diamond drilling at the Ontario magnetite property of El Sol Gold Mines Ltd., company reports. Grade, length and width of deposit to date are considered most encouraging, company's consulting engineers state.

Grade of the drill intersections is averaging above 31% iron.

Metallurgical tests are being carried out by Lakefield Research Ltd. and University of Toronto. Work still is in its early stages but tests to date indicate that iron-bearing magnetite can be beneficiated and pelletized as a high grade iron product.

El Sol Gold Mines' property covers 124 claims in Papaonga Lake area, about 65 miles northwest of Sioux Lookout. Operations of company are directed by Continental Mining Exploration Ltd. (formerly Newkirk Mining Corporation Ltd.).

As We Went to Press . . .

House Appropriations Subcommittee has cut the $30-million appropriation for stop-gap minerals purchases asked for in deficiency appropriations for fiscal 1957. Senate will try to put it back.

In addition to St. Joe's and American Metals' more widely known operations in the Bathurst area of New Brunswick, at least three more companies, Anaconda, Texas Gulf Sulphur and Kennecott, are active. Company spokesmen are close-mouthed concerning results. Kennecott reports exploration in the district.

An Anaconda spokesman said only, "Anaconda Co. is engaged in active drilling and geological study in New Brunswick near the town of Bathurst.

"Early indications have revealed sulphide mineralization, but a great deal of work—both geological and metallurgical—must be accomplished before the value of the development is known."

A major U.S. iron ore company reportedly has purchased St. John del Rey property, Minas Gerais, Brazil. The property contains "extra-rich" iron ore "and other minerals than gold" heretofore ignored by the British management.

In Ambrosia Lake area, Rio de Oro Uranium Mines, Inc. has a new mine, Ike No. 1, where shaft sinking is in progress. Ore is at 950 ft and ranges from 50 to 150 ft thick.

International Nickel Co. has signed agreement with Texas Gulf Sulphur Co. to pilot-plant a process for recovering elemental sulphur from smelter gas. If pilot is successful, a large sulphur unit will be built near Inco iron recovery unit at Copper Cliff.

Construction got under way at U. S. Steel's American Bridge Div.'s 5,000-tpd iron ore sintering plant at Youngstown, Ohio. The $10-million plant will be onstream this summer.

Northern Rhodesia registered another copper producer with Bancroft Mines Ltd. hoisting first ore in January. Initial output will be some 40,000 long tons metal annually, according to Sir Ernest Oppenheimer, chairman, Anglo-American Corp. of South Africa Ltd. Plans call for expansion over 3 years to 85,000 tons.

Vanadium Corp. has been granted a 2,460-sq mile manganese concession in Northern Rhodesia. Concession is Chilili East Manganese area near 200-sq mile concession purchased by VCA in 1955.

Bills to permit U. S. Steel's Columbia Geneva Steel Division to construct railroad spur and obtain water rights have been introduced into Wyoming legislature. Firm is reported to be planning $16-million magnetic concentrator-mine. See Wyoming regional news.

Government sources in New Zealand have announced a uranium strike valued at more than $30-million at Buller Gorge.

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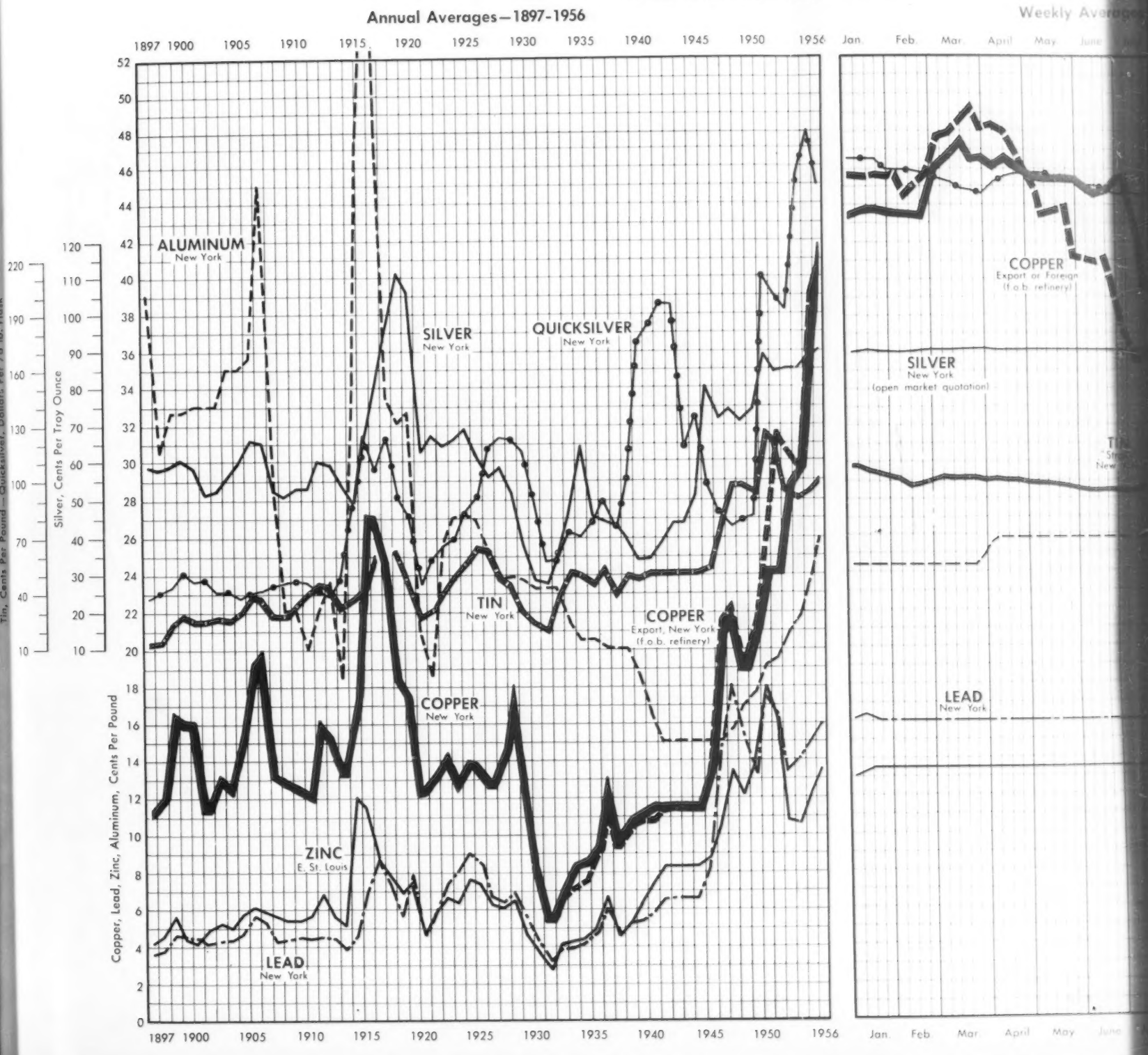
Tin, Cents Per Pound — Quicksilver, Dollars Per 76 lb. Flask

E&MJ Metal Prices

As Published in Engineering & Mining Journal and E&MJ Metal and Mineral Markets

McGraw-Hill Publishing Company, Inc., New York



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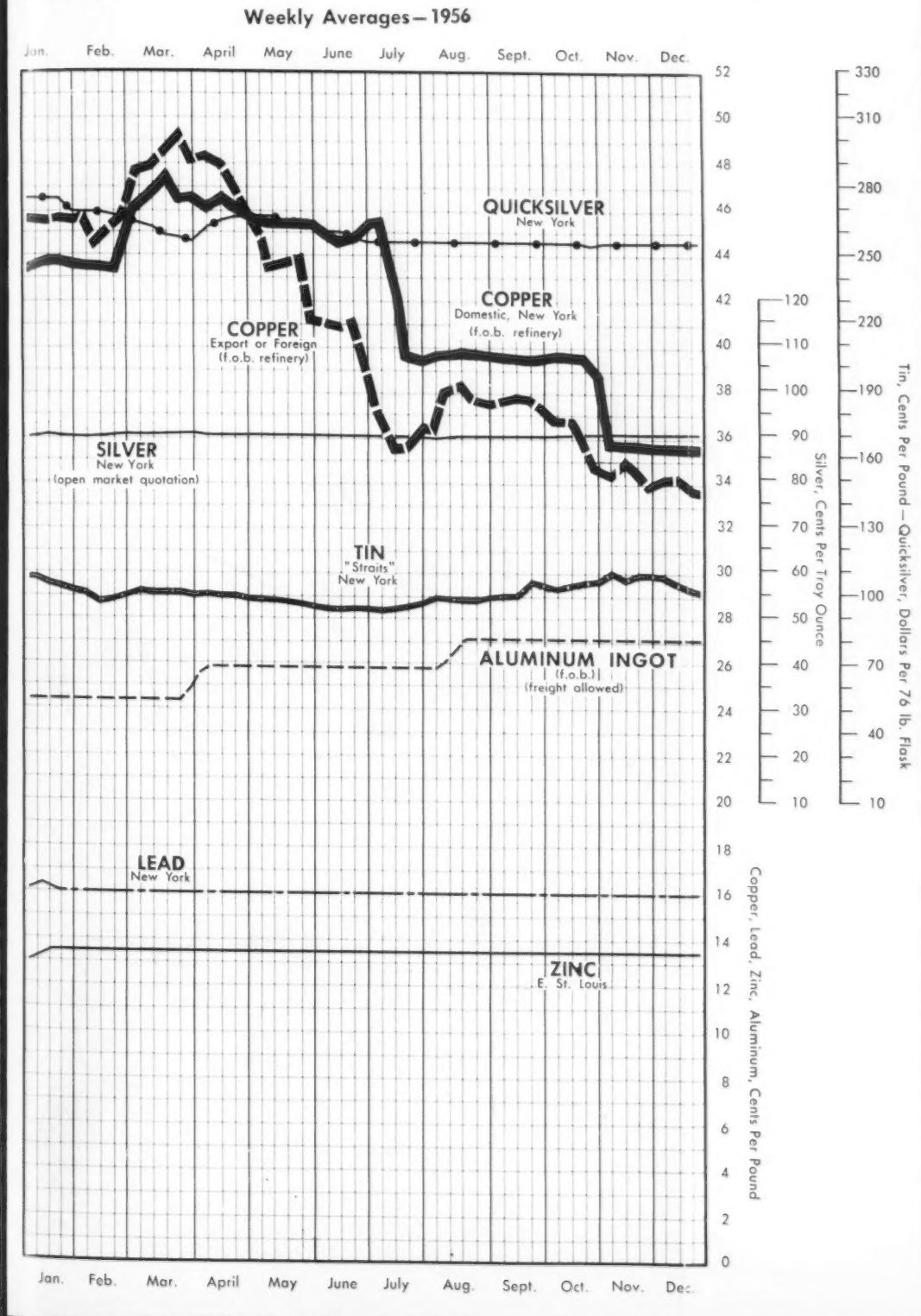

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1897	11.29	.....	3.580	4.120	13.67	59.790	38.50	39.00
1898	12.03	.....	3.780	4.570	15.70	58.260	40.70	30.58
1899	16.67	.....	4.470	5.750	25.12	59.580	43.63	32.72
1900	16.19	.....	4.370	4.390	29.90	61.330	51.00	32.72
1901	16.11	.....	4.330	4.070	16.74	58.950	47.00	33.00
1902	11.026	.....	4.069	4.840	26.79	52.160	48.03	33.00
1903	13.235	.....	4.237	5.191	28.09	53.570	41.32	33.00
1904	12.823	.....	4.309	4.931	27.99	57.221	41.00	35.00
1905	15.590	.....	4.707	5.730	31.358	60.352	38.50	35.00
1906	19.278	.....	5.657	6.048	39.819	66.791	40.90	35.75
1907	20.004	.....	5.325	5.812	38.166	65.237	41.50	45.00
1908	13.208	.....	4.200	4.578	29.465	52.864	44.84	28.70
1909	12.982	.....	4.273	5.352	29.725	51.502	46.30	22.00
1910	12.738	.....	4.446	5.370	34.123	53.486	47.06	22.25
1911	12.376	.....	4.420	5.608	42.281	53.304	46.54	20.07
1912	16.341	.....	4.471	6.799	46.096	60.835	42.46	22.01
1913	15.269	.....	4.370	5.504	44.252	59.791	39.54	23.64
1914	13.602	.....	3.862	5.061	34.301(d)	54.811	48.31	18.63
1915	17.275	.....	4.673	13.054	38.590	49.684	87.01	33.98
1916	27.202	.....	6.858	12.634	43.480	65.661	125.49	60.71
1917	27.180	.....	8.787	8.813	61.802	81.417	106.30	51.59
1918	24.628	.....	7.413	7.890	88.750	96.772	123.47	33.53
1919	18.691	.....	5.759	6.988	63.328	111.122	92.15	32.14
1920	17.456	.....	7.957	7.671	48.273	100.900	81.12	32.72
1921	12.502	.....	4.545	4.655	29.916	62.654	45.46	21.11
1922	13.382	.....	5.734	5.716	32.554	67.528	58.95	18.68
1923	14.421	.....	7.267	6.607	42.664	64.873	66.50	25.41
1924	13.024	.....	8.097	6.344	50.176	66.781	69.76	27.03
1925	14.042	.....	9.020	7.622	57.893	69.065	83.13	27.19
1926	13.795	.....	8.417	7.337	65.285	62.107	91.90	26.99
1927	12.920	.....	6.755	6.242	64.353	56.370	118.16	25.40
1928	14.570	.....	6.305	6.027	50.427	58.176	123.51	24.300
1929	18.107	.....	6.833	6.512	45.155	52.993	122.15	24.300
1930	12.982	.....	5.517	4.556	31.694	38.154	115.01	23.787
1931	8.116	.....	4.243	3.640	24.467	28.700	87.35	23.300
1932	5.555	.....	3.180	2.876	22.017	27.892	57.93	23.300
1933	7.025	6.713	3.869	4.029	39.110	34.727	59.23	23.300
1934	8.428	7.271	3.860	4.158	52.191	47.973	73.87	23.300
1935	8.649	7.538	4.065	4.328	50.420	64.273	71.99	20.000
1936	9.474	9.230	4.710	4.901	46.441	45.087	79.92	20.000
1937	13.167	13.018	6.009	6.519	54.337	44.883	90.18	19.917
1938	10.000	9.695	4.739	4.610	42.301	43.225	75.47	20.000
1939	10.965	10.727	5.053	5.110	50.323	39.082	103.94	20.000
1940	11.296	10.770	5.179	6.335	49.827	34.773	176.86	18.691
1941	11.797	10.901	5.793	7.474	52.018	34.783	185.02	16.500
1942	11.775	11.684	6.481	8.250	52.000	38.333	196.35	15.000
1943	11.775	11.700	6.500	8.250	52.000	44.750	195.21	15.000
1944	11.775	11.700	6.500	8.250	52.000	44.750	118.36	15.000
1945	11.775	11.700	6.500	8.250	52.000	51.928	134.89	15.000
1946	13.820	14.791	8.109	8.726	54.544	80.151	98.24	15.000
1947	20.958	21.624	14.673	10.500	77.949	71.820	83.74	15.000
1948	22.038	22.348	18.043	13.589	99.250	74.361	76.49	15.733
1949	19.202	19.421	15.364	12.144	99.336	71.930	79.46	17.000
1950	21.235	21.549	13.296	13.866	95.539	74.169	81.26	17.713
1951	24.200	26.258	17.500	18.000	127.077	89.368	210.13	19.000
1952	24.200	31.746	16.467	16.215	120.473	84.941	199.097	19.410
1953	28.798	30.845	13.489	10.855	95.845	85.188	193.032	20.931
1954	29.694	29.889	14.054	10.681	91.838	85.250	264.386	21.784
1955	37.491	39.115	15.138	12.229	94.735	89.099	290.348	23.668
1956	41.818	40.434	16.013	13.494	101.409	90.826	259.923	26.010

(a) Lake copper 1897–98: domestic market since 1932. (b) New York delivery 1898–1902. (c) 99 per cent in 1897 to 1920, inclusive: Straits quality thereafter. (d) Average for eleven months. (e) New York market. . . . All quotations in cents per lb, except for silver, which are in cents per troy oz, and (f) quicksilver, which are in dollars per flask of 76 lb. See opposite page and reverse for weekly average prices for 1956.

E & M J Weekly Average Metal Prices—1956

	COPPER		LEAD	ZINC	TIN	SILVER	QUICK-SILVER	ALUMINUM 99% Plus, Ingot
	Domestic, Refinery	Foreign, Refinery	N. Y., Common	E. St. Louis Prime Western	N. Y., "Straits"	N. Y., Foreign	N. Y.	
Jan. 4	43.675	45.570	16.054	13.000	108.225	90.500	275.000	24.400
11	43.755	45.563	16.500	13.377	106.688	90.600	275.000	24.400
18	43.905	45.679	16.083	13.500	105.021	90.500	275.000	24.400
25	43.685	45.488	16.000	13.500	103.854	90.200	271.000	24.400
Feb. 1	43.580	45.788	16.000	13.500	101.792	90.025	270.000	24.400
8	44.440	44.629	16.000	13.500	98.979	90.275	270.000	24.400
15	43.015	45.117	16.000	13.500	99.450	90.969	268.000	24.400
22	45.025	45.833	16.000	13.500	100.300	91.563	268.000	24.400
29	46.210	47.838	16.000	13.500	103.917	91.100	264.000	24.400
Mar. 7	46.805	47.942	16.000	13.500	100.854	91.100	262.000	24.400
14	47.465	48.513	16.000	13.500	101.604	91.125	259.000	24.400
21	46.380	49.121	16.000	13.500	101.188	91.125	258.000	24.400
28	46.540	48.242	16.000	13.500	99.125	91.200	257.000	24.690
Apr. 4	46.050	48.371	16.000	13.500	100.188	91.000	262.000	25.855
11	46.835	48.117	16.000	13.500	99.688	90.925	265.000	25.900
18	46.055	47.275	16.000	13.500	99.354	91.000	268.000	25.900
25	45.930	46.188	16.000	13.500	98.708	90.750	268.000	25.900
May 2	45.655	45.042	16.000	13.500	98.458	90.750	268.000	25.900
9	45.465	43.625	16.000	13.500	97.771	90.750	268.000	25.900
16	45.615	43.829	16.000	13.500	97.271	90.750	265.000	25.900
23	45.590	43.917	16.000	13.500	97.125	90.750	264.000	25.900
30	45.488	41.092	15.000	13.500	96.050	90.750	263.000	25.900
June 6	44.960	41.038	16.000	13.500	94.083	90.750	261.333	25.900
13	44.715	40.988	16.000	13.500	94.229	90.700	260.000	25.900
20	44.975	41.225	16.000	13.500	95.042	90.300	257.000	25.900
27	45.420	39.583	16.000	13.500	95.063	90.250	256.000	25.900
July 4	45.481	36.967	16.000	13.500	94.075	90.250	255.213	25.900
11	42.750	35.750	16.000	13.500	94.958	90.125	255.000	25.900
18	39.450	35.483	16.000	13.500	95.771	90.125	255.000	25.900
25	39.440	36.271	16.000	13.500	96.500	90.125	255.000	25.900
Aug. 1	39.475	36.217	16.000	13.500	99.375	90.125	255.000	25.900
8	39.510	38.021	16.000	13.500	98.625	90.300	255.000	25.900
15	39.675	38.092	16.000	13.500	98.521	90.700	255.000	26.693
22	39.670	37.392	16.000	13.500	98.833	90.750	255.000	27.100
29	39.650	37.354	16.000	13.500	99.354	90.750	255.000	27.100
Sept. 5	39.644	37.588	16.000	13.500	100.175	90.750	255.000	27.100
12	39.590	37.896	16.000	13.500	101.479	90.750	255.000	27.100
19	39.510	37.779	16.000	13.500	106.917	90.750	255.000	27.100
26	39.645	37.204	16.000	13.500	104.792	90.750	255.000	27.100
Oct. 3	39.690	36.833	16.000	13.500	103.042	90.850	255.000	27.100
10	39.615	36.883	16.000	13.500	104.271	91.000	255.000	27.100
17	39.581	35.954	16.000	13.500	106.075	91.094	255.000	27.100
24	39.025	34.671	16.000	13.500	106.292	91.375	254.000	27.100
31	**35.820**	**33.354**	**16.000**	**13.500**	**107.958**	**91.375**	**255.000**	**27.100**
Nov. 7	35.700	35.058	16.000	13.500	111.825	91.375	255.000	27.100
14	35.700	34.675	16.000	13.500	108.875	91.375	255.000	27.100
21	35.700	34.404	16.000	13.500	111.292	91.375	255.000	27.100
28	35.688	33.888	16.000	13.500	110.500	91.375	255.000	27.100
Dec. 5	35.690	34.246	16.000	13.500	109.813	91.375	255.000	27.100
12	35.655	34.217	16.000	13.500	106.604	91.375	255.000	27.100
19	35.655	33.783	16.000	13.500	103.604	91.375	255.000	27.100
26	35.631	33.580	16.000	13.500	101.725	91.375	255.000	27.100

Major Metals

Dr. M. A. Kriz
Chief, Foreign Research Div., Research Dept. Federal Reserve Bank of New York

"Gold output rose by more than 1-million oz and foreign nations built monetary reserves."

Frank H. Wemple
Treasurer
Handy & Harman

"Silver consumption and production increased, lend-lease returns increased Treasury free stocks."

George H. Cleaver
Market Editor
Engineering & Mining Journal

"Copper from new sources will substantially lift supply, but the price is not likely to dip below 30c."

R. L. Ziegfeld
Secretary
Lead Industries Assn.

"Lead supply and demand were substantially held in balance; the stockpile was the major influence."

Charles R. Ince
Vice President and Sales Manager, St. Joseph Lead Co.

"Zinc reached near record consumption and new highs in domestic smelter production and imports."

Verne D. Johnston
Consultant
Oglebay, Norton & Co.

"Iron ore requirements for next 27 years show an increasing need for beneficiated ores."

J. Donald Hanawalt
Vice President and Manager, Magnesium Department, Dow Chemical Co.

"Magnesium consumption hit a new peacetime high and 1957 should match it."

Robert D. Nininger
Assistant Director for Exploration, Raw Materials, AEC

"Uranium mill capacity reached 8,960 tons daily in the U. S. with ore reserves at 60-million tons."

George P. Lutjen
Managing Editor
Engineering & Mining Journal

"Titanium sponge production, which doubled in 1956, should double again in 1957 as more problems are solved."

Irving Lipkowitz
Assistant to the President
Reynolds Metals Co.

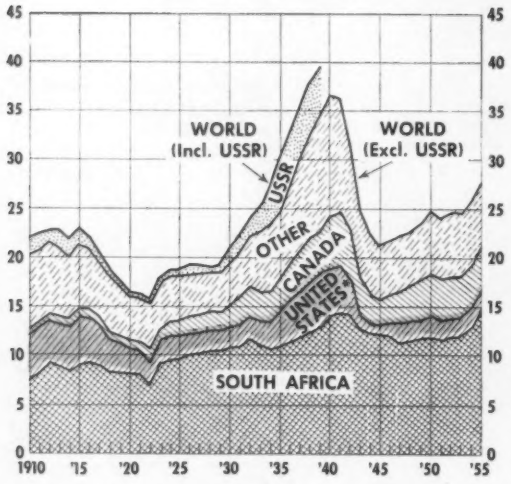
"Aluminum producers set a new primary output record for the fifth year in succession."

John R. O'Connell Jr.
Assistant Market Editor
Engineering & Mining Journal

"Tin surpluses caused by sale of the Texas City smelter promise to ease world tin prices."

World Output of Gold

(Millions of fine ounces)



Note: All 1956 data are provisional
* Including Philippines through 1939

World Gold Production

(Millions of fine ounces)

	1956*	1955	1954	1953	1945	1940
North America:						
Canada	4.4	4.5	4.4	4.1	2.7	5.3
United States	1.9	1.9	1.9	2.0	0.9	4.9
Latin America:						
Mexico	0.4	0.4	0.4	0.5	0.5	0.9
Colombia	0.5	0.4	0.4	0.4	0.5	0.6
Chile	0.1	0.1	0.1	0.1	0.2	0.3
Nicaragua	0.2	0.2	0.2	0.3	0.2	0.2
Africa:						
Union of South Africa	15.9	14.6	13.2	11.9	12.2	14.0
Gold Coast	0.6	0.7	0.8	0.7	0.5	0.9
Southern Rhodesia	0.5	0.5	0.5	0.5	0.6	0.8
Belgian Congo	0.4	0.4	0.4	0.4	0.3	0.6
Asia:						
India	0.2	0.2	0.2	0.2	0.2	0.3
Philippines	0.4	0.4	0.4	0.5	—	1.1
Australia	1.0	1.1	1.1	1.1	0.7	1.6
Total	26.4	25.4	24.0	22.7	19.5	31.6
Other countries, excluding USSR	2.1	2.1	2.1	2.0	1.6	5.1
World, excluding USSR	28.6	27.5	26.1	24.7	21.1	36.7

* Tentative figures based on preliminary data.
Note: Figures may not add up to totals because of rounding.

Gold

Dr. M. A. Kriz*
New York, N. Y.

THE YEAR 1956 was marked by three principal gold developments. First, world gold output rose by over 1-million oz; this was the third sizable consecutive increase, even though somewhat smaller than in 1955 and 1954. Second, almost as much newly mined gold flowed into official monetary stocks as in 1955, and prices for bar gold on the international gold markets outside the United States remained close to $35 per oz; the Middle Eastern crisis thus did not touch off a wave of hoarding demand as did the Korean outbreak in mid-1950. Third, foreign countries as a whole continued to build up monetary reserves, including dollar assets; they thus increased their international liquidity for the fifth consecutive year.

Last year was also marked, however, by renewed or accentuated inflationary strains that, in a number of countries, brought about balance-of-payments difficulties and sizable gold and dollar losses. The United Kingdom experienced particularly large losses because of pressures on sterling which seemed more of a speculative than a commercial character. Toward the year-end, however, the determination of the U. K. to defend sterling, together with the massive support granted by the International Monetary Fund and the U. S. Export-Import Bank, gave grounds for hope that the tide would turn in 1957. In many other countries, too, the efforts to restore and maintain monetary stability, together with the much greater strength of their economies than only a few years ago, augured well for the reestablishing of a sustainable economic balance, internally as well as externally.

World production of gold (excluding the USSR) amounted last year to some 28.6-million fine oz, or about 1.1-million more than in 1955 (see table), on the basis of preliminary or incomplete data available at the year-end. Last year's rise was, therefore, smaller than the increases of 1.4-million oz each in 1955 and 1954, which followed a period of relative stability of world gold output from 1950 through 1953. Despite the smaller rises in 1956, however, world gold output expanded at a rate of about 4%, as against 2.5% from 1945 to 1953; in 1954 and 1955, it had grown at the rate of over 5% a year. Last year's output was more than 7-million oz above the 1945 postwar low, and 8-million oz short of the 1940 all-time peak (see above chart).

The 1.1-million ounce rise in last year's output was due entirely to the increase in South African production. At some 15.9-million oz—the highest ever recorded—South African output in 1956 was 1.3-million or 9% above 1955. From 1951 to 1956, South Africa's production rose by 37%. It is also worth noting that last year's output in South Africa was 1.5-million oz above 1941, which was the record year that had culminated the last previous expansion phase.

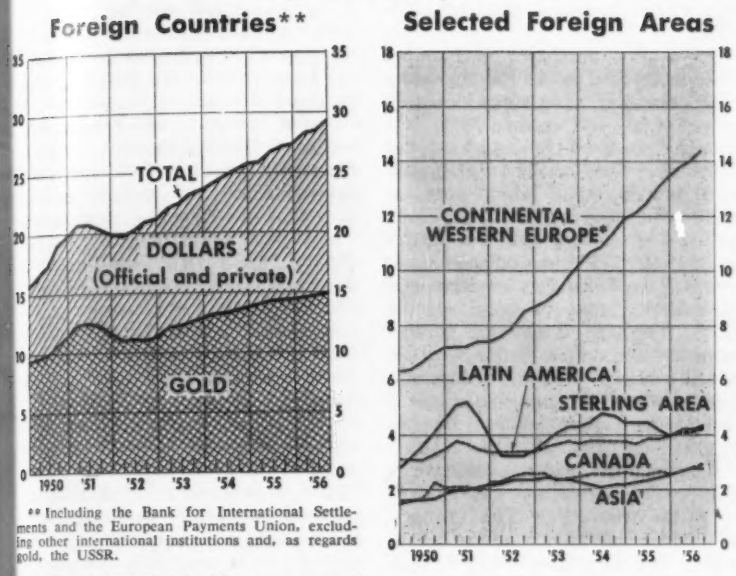
The current expansion in the South African output began in 1953. As in the earlier years, the 1956 rise was attributable principally to the continuing increase in the output of the new mines of the Orange Free State and of the Far West Rand extensions of the Transvaal. Output of these new mines increased from less than 0.5-million oz in 1953 to 1.1-million in 1954, 2.2-million in 1955, and probably over 3-million in 1956; toward the year-end, it was equal to nearly 30% of the production of the Transvaal, which comprises mainly the older mines. Output of the new mines is expected to expand further over the coming years; however, production of the Transvaal mines, which had begun to rise in 1952 after a decline during the war and the earlier postwar years, also rose slightly in 1956.

In Canada, last year's output was somewhat smaller than in 1955—

* Author is chief, Foreign Research Div., Research Dept., Federal Reserve Bank of New York. Views expressed are his own and not meant to reflect those of the bank.

Gold and Dollar Holdings

(Billions of dollars)



** Including the Bank for International Settlements and the European Payments Union, excluding other international institutions and, as regards gold, the USSR.

Holdings include official gold reserves (reported or estimated), official and private short-term dollar holdings as reported by banks in the U. S.

* Includes holdings of Turkey, and those of the Bank for International Settlements for the European Payments Union as well as for its own account.

† Excluding sterling, French-franc, and Dutch-guilder areas.

Note: Holdings include official gold reserves (reported or estimated), official and private short-term dollar holdings as reported by banks in the U. S.

Short-term dollar holdings consist almost wholly of sight and time deposits, U. S. Treasury bills and certificates of indebtedness, and bankers' acceptances; in addition, there is a small amount of commercial paper and of foreign claims receivable in foreign currencies.

about 4.4-million oz. During recent years, Canada's output has remained largely stationary at 4.3- to 4.5-million; the drop to 4.1-million in 1953 was due to labor difficulties in certain mining areas. Nevertheless, at its 1956 level Canadian output is only about 15% below the all-time peak of 1941. A growing portion of Canadian gold is derived as a by-product from base metal mining, which is expanding rapidly in the various new and old areas.

U. S. gold production was about 1.9-million oz (on the basis of the first 10 months), or about the same as in earlier years. In Australia, India, and the Philippines, on the Gold Coast, in Belgian Congo, in Southern Rhodesia, and in Latin America, production remained generally stationary. No data are, of course, available for the USSR, probably the world's second largest producer.

Gold-mining costs continued to rise last year in most countries. In South Africa, the average working costs per ton milled rose by 4% during January-September, as against 4% during the entire year 1955; this compares with a rise of 6% in 1954 and 8% in 1953. Measured per ounce of gold produced, however, costs actually declined slightly; this was largely attributable to the increase in the gold yield in the Orange Free State Mines. The supply of native labor, which improved in 1954 and 1955 after having been an important production bottleneck, appears to have become tighter again last year; adequate labor supply is one of the prerequisites for a steady rise in output. Another condition is sufficient electric power, the shortage of which, however, was less acute in 1955 and 1956. Working profits rose again last year—by 8% during January-September. In addition, certain South African mines derived sizable profits from the production of uranium; such profits last year equaled almost one half of the working profits from gold.

In Canada, costs likewise continued to rise; this caused some mines to turn to higher-grade ores and others to shut down. Emergency assistance to gold mines, which was first granted in 1948 and renewed several times, was extended last year to 1957 and 1958. As in 1954 and 1955, all mines eligible for subsidy elected to channel their output into official reserves—a requisite for receiving subsidies—rather than sell on the Canadian free market, which as noted below was established in March 1956, or on the free markets elsewhere. During the early part of the year, the Canadian dollar stood close to parity with the U. S. dollar, but the premium reappeared in the spring and increased to over 4% in the latter part of the year, which brought the Candian gold price to about Can. $33.60 per oz.

Assistance was also granted in the form of subsidy to producers in Australia, Colombia, and the Philippines; in Australia, the subsidy scheme was extended last year for a further three years. As in Canada, such subsidization has been designed to benefit marginal producers, the amount of subsidy being related to the presumed economic needs of various categories of mines, and subject to various conditions. On the Gold Coast, the government extended direct grants to enable the mines to meet part of the cost of new social benefits. In South Africa, certain tax reductions were granted to producers through the restoration of the gold-mining tax formula applied before 1951, as well as in other ways. That tax formula had been replaced in 1951 by stricter taxation, on the ground that the devaluation of the South African pound in 1949 had benefited gold producers; last year's return to the pre-1951 taxation formula was officially justified by the fact that the advantages of devaluation had since been absorbed by the rise in costs.

Flow of gold. Value of last year's gold output outside the USSR, at the official U. S. price of $35 per fine oz, was about $1-billion. In addition, the USSR was reported to have sold in Continental Western Europe or in the London gold market varying amounts of gold during the year; however, it appeared that last year's Russian sales were smaller than the $75-million reported to have been sold during each of the preceding three years. Of last year's total supply of new gold, some three-fifths—about $600-million—was added to the monetary reserves of central banks and governments and international financial institutions; $650-million had been added in both 1954 and 1955. The remaining two-fifths of the available supply went into industrial and professional uses or was absorbed by private demand. In Western Europe, private demand for gold, which had already declined in 1955 and 1954, was dormant during the first half of the year or so; it seems to have revived somewhat after the outbreak of the Middle Eastern crisis, but

apparently remained small. In the Middle and Far East, where private demand for gold was large even before the Middle East crisis, more gold was probably absorbed last year than in 1955; but in these areas gold is used as an active means of payment, and their persistent absorption of gold cannot be regarded as primarily evidence of hoarding.

The monetary gold stock of the U. S. was at the end of 1956 $305-million higher than a year previous. During January-September—the period for which full data have been published at this writing—it increased by $279-million, of which $80-million (net) was purchased from other countries and $175-million from the International Monetary Fund; these were the first net purchases for any extended period since 1952.

The countries outside the U. S. added to their monetary stocks chiefly by purchases from new production. The bulk of the newly-mined gold was disposed of through the London gold market. South Africa, which produces some 80% of the sterling area's gold output, sold in 1956 most of its newly-mined gold in London. South Africa has no commitment to sell gold there but, according to an official South African statement, "the maximum use" is made of the London market because, "having regard to the international nature and the leading position of the London market, it appears unlikely that a better price could normally be obtained elsewhere." In addition, London also received the sizable output of British West Africa and Southern Rhodesia. Gold originating from various nonsterling-area countries was reportedly also sold in London.

Principal buyers in London were the central banks in Western Europe. One reason for this was that Continental Western European central banks were able to purchase gold a few cents below $35 to settle their indebtedness vis-a-vis the European Payments Union, which at the debtor's option can be done either in dollars or in gold valued at $35. Some gold was also sold to private operators, especially in the Middle and Far East.

While sales of gold in London are unrestricted, purchases by British and other sterling-area residents are subject to license, which is granted only for limited quantities of gold for trading and industrial purposes; residents of other countries may buy gold only if payment is made in American-account or Canadian-account sterling, which has always been fully convertible into dollars, or in the so-called registered sterling, which is issued only against dollars or against gold itself, and which was established for this purpose at the time of the reopening of the London gold market in March 1954.

As trading developed in London, the London gold price became increasingly important. The price generally moves with the sterling-dollar exchange rate. As in 1954 and 1955, the dollar equivalent of the London gold price remained last year almost entirely within the range of the U. S. buying and selling prices of $34.9125 and $35.0875 ($35 plus or minus¼%) at which the Federal Reserve Bank of New York, acting on behalf of the U. S. Treasury, deals with foreign monetary authorities. Sellers thus received a higher price in London, and foreign monetary authorities found it cheaper to acquire gold in London than in New York.

A noteworthy feature of last year's gold-price developments was the failure of the Middle East crisis to touch off a boom in gold and a sharp rise in prices, such as followed the Korean outbreak in mid-1950. Immediately after Egypt's seizure of the Suez Canal, gold prices rose considerably in the Far and Middle Eastern markets, as noted below, but the rise in those Western European markets where gold is traded internationally, principally London and Zurich (but not Paris, which is a domestic market) was moderate. The dollar equivalent of the London gold price reached a high of $35.08 during the week ended Aug. 3, but subsequently declined and in the latter part of December fell to $34.88, the lowest price that had been recorded since the reopening of the London market.[1] Among the reasons for this decline was apparently the lack of demand for gold on the part of central banks, the reluctance of dealers to stock gold, uncertainties regarding transport, and difficulties of financing.

The price at which gold is traded directly for U. S. dollars in foreign markets other than London remained within a few cents of the London gold price. In Zurich, for instance, the U. S. dollar price for bar gold moved very closely with the London price. In Tangier, however, the dollar price of gold bars was lower during most of the year than the gold prices in London and Zurich; this was, of course, attributable to the political changes in North Africa, as a result of which much of the gold held in Tangier for safekeeping reportedly moved to other centers.

In markets where gold is traded in local currencies, the price for bar gold did not follow the London price, but at the same time did not deviate from it very much; this reflected, of course, local circumstances and the special features of the local markets. In Paris, the franc price of bar gold increased by about 6% during January-July; it then fell somewhat, and after the outbreak of the Middle East crisis remained below the July peak. Its equivalent in U. S. dollars, as converted at the "parallel" market exchange rate, rose from $36.00 at the end of 1955 (it had been quoted as low as $35.60 in January 1955) to $36.50 just before the seizure of the Suez Canal by Egypt in July; it subsequently declined and at the year-end stood at $36.10. U. S. dollar equivalents for bar gold in Brussels and Milan showed smaller fluctuations than the Paris price. In Beirut, the dollar equivalent went as high as $35.75 in November, but declined toward the year-end. In Hong Kong, the price of bar gold, which had begun to rise in mid-1955, reached the equivalent of $38.50 in early November, the highest since 1952; at the year-end it stood at about $38.00. In Bombay, where the dollar equivalent (at the official rate of exchange) has been especially high during recent years, it rose from $52.00 in December 1955 to $59.35 in November 1956, the highest since 1952.

Gold coin quotations, which—in countries with domestic gold markets—are usually the most sensitive indicators of sentiment in national as well as international affairs, increased sharply in a number of centers. In Paris, the dollar equivalent per fine ounce of the price of the Napoleon rose as high as $46.30 in November, compared with $39.95 at the end of 1955 and $36.70 in June 1955 (the lowest in recent years); it was $45.60 at the year-end. U. S. dollar equivalent of the sovereign in Milan went as high as $49.50 in November, compared with $39.90 at the end of 1954.

Belgium-Luxembourg and Canada last year permitted residents as well as nonresidents to buy and sell gold and import and export gold freely. Belgium-Luxembourg lifted restrictions on gold trading in January 1956; payments for international transactions in gold have to be made in Belgian, Luxembourg, or foreign banknotes, or through the free exchange market for capital transactions. Prior to January 1956, the Brussels market had been restricted to domestic transactions. In Canada, all restrictions on gold transactions were removed in March 1956. Canadian gold producers who wish to forego

[1] Unless otherwise, stated, all prices quoted in this article are approximate weekly averages.

aid under the emergency assistance arrangements noted above are free to sell their gold wherever they wish, subject only to the obligation to report production and sales to the authorities.

Greek imports of gold (except jewelry) were in January 1956 freed from all exchange control and customs formalities and exempted from all duties and taxes; importers are not required to declare them to the monetary authorities. Greece has had a free domestic market for a number of years. Thailand, which temporarily prohibited the import of gold in 1955 in order to conserve foreign exchange for essential commodities, lifted this ban last year; however, it established a quota for gold imports. In West Germany, the import of gold coins by travelers, whether residents or nonresidents, was authorized in June; gold coins may be traded internally in Germany, but their export is not allowed.

These measures, the most important of which was the establishment of free markets in Belgium-Luxembourg and Canada, do not appear to have noticeably affected the earlier pattern of international trading in gold. Nor does the freeing of the gold markets and trading seem to have increased the proportion of newly-mined gold that flows into private hoards. The various arrangements regarding domestic trading in gold reflect the particular needs of the countries concerned at the time; they do not in any way impair the principle that gold should, to the maximum extent practicable, be channeled to and held in official reserves where it will readily serve monetary purposes.

Monetary reserve changes. Principally as a result of accretions of newly-mined gold, monetary gold reserves of central banks and governments and international financial institutions continued to grow throughout 1956. In September 1956, they stood at about $38,500-million (excluding the USSR), or $630-million more than a year earlier. Of the September 1956 total, the U. S. held $22,032-million ($287-million above September 1955; U. S. stock rose by a further $26-million during October-December 1956, and stood at the year-end at $22,058-million). Other countries, together with the Bank for International Settlement and the European Payments Union, held about $14,750-million ($375-million above September 1955); and the International Monetary Fund $1,711-million ($40-million below September 1955). In September 1956, the U. S. consequently held 57% of the world monetary gold stock.

Besides gold, foreign countries in September 1956 held about $13,200-million in the form of dollars, on both official and private account (including primarily deposits in U. S. banks and short-term U. S. Government securities and bankers' acceptances) or about $1,700-million more than a year previous. This rise was due, as in earlier years, to a "cash" deficit in the over-all balance of payments of the U. S.; the enlarged trade surplus, reflecting an even faster increase in merchandise exports than that in imports, was more than offset by large net payments abroad for services (travel, shipping, etc.), by private capital outflow, and by U. S. Government outlays on account of "defense support" and other aid programs as well as for military expenditures abroad.

Total gold and dollar holdings of foreign countries in September 1956 amounted to $28,000-million, as against $25,900-million a year earlier (see chart). They were $13,200-million or nearly 100% higher than in September 1949, the date of the general currency devaluations, and $9,100-million, or about 50%, higher than in March 1952, before the current build-up of gold and dollar holdings of foreign countries. The rise in gold and dollar holdings of foreign countries as a whole was thus truly remarkable; but it was not faster than the growth of world trade in general, and of United States' trade in particular.

These aggregates of course conceal important changes in the gold and dollar holdings of particular countries and areas (see chart). During the twelve months ended September 1956, the holdings of Continental Western Europe increased by $1,300-million; of this rise, $849-million went to West Germany and $249-million to Switzerland; France lost some $220-million. Gold and U. S. dollar holdings of Canada rose by $189-million during October 1955-September 1956. Canada's foreign trade deficit steadily increased in 1956; at the same time, however, capital inflow expanded substantially and more than offset the deficit on current account. Aggregate holdings of Latin American countries rose by $221-million; most of this increase went to Brazil ($113-million), Mexico ($80-million), and Venezuela ($146-million), while the holdings of Argentina declined $137-million. Gold and dollar holdings of nonsterling Asian countries increased by some $322-million, largely because of increases in the holdings of Japan ($211-million) and the Philippines ($32-million). (See charts on page 77.)

The aggregate gold and official and private dollar holdings of sterling-area countries remained practically unchanged at some $3.9-billion during the year ended September 1956, but central gold and official dollar assets held by the U. K. as the area's banker fell by $17-million despite the capital windfall of $177-million from the sale of the Trinidad Oil Co. to U. S. interests; they fell $363-million further in October and November. In December they rose by $168-million to $2,133-million, almost entirely because of the $561-million drawing on the International Monetary Fund, which was offset, among other things, by payments on account of the American and Canadian post-war loans (part of it in a special account pending the sanction by the U. S. Congress of the waiver of interest payments on these loans), and by losses attributable to exchange support operations in early December before the announcement of the Fund's assistance.

The gains and losses of gold and dollars reflected great differences in the underlying economic conditions of various countries. Among such differences were discrepancies in the extent of the inflationary rise in demand, and price and cost disparities; the more pervasive the domestic demand, and the higher the prices and costs, the bigger was the rise in the trade deficit (or the decline in the trade surplus, as the case may be) as merchandise imports tended to rise and exports to decline. Psychological factors were, however, also important, with working balances of a given currency being allowed to run down for fear of its devaluation or, on the contrary, being increased in the expectation of possible exchange profits.

Sterling, a currency that is one of the three main forms—with gold and the U. S. dollar—in which other countries hold their external liquid reserves, was particularly vulnerable to pressures of this sort. Many traders in the sterling area, with foreign currency payments to provide for, covered their commitments as soon as they could, and many traders in nonsterling countries, with sterling payments to make, postponed purchasing sterling or tended to make use of sterling credit; these "leads and lags" throughout the world increased greatly during the Middle East crisis, and together with other speculative pressures seem to have been the principal factors behind Britain's large gold and dollar losses in October and November 1956. Britain actually expanded

(Continued on p 270)

Silver

Francis H. Wemple
Handy & Harman

STABILITY again characterized the silver market in 1956. Silver laws in the U. S. governing the purchase and sale of silver by the Treasury Department provided the main reason for the narrow range of price fluctuations. The Treasury buying price of 90.5c for domestic production kept the market from going very much below this level, and its selling price to U. S. consumers limited price increases during periods of peak demand.

U. S. consumption of silver in the arts and industries amounted to 100-million oz, which was the same as in 1955. Continued gains in many of the industrial uses were offset by a decline in consumption for sterling and plated ware. Largest percentage increases took place in the wide variety of forms and alloys used in the electrical and electronics field, and in brazing alloys for metal joining. Industrial uses probably accounted for well over 50% of all silver consumed in this country during the year just ended. Rate of consumption was fairly even throughout 1956, following the pattern of recent years. The increase in industrial requirements, as compared to arts, has tended to level out seasonal fluctuations.

Price changes in the New York market for the most part were small and resulted from relatively minor variations in the balance between demand and supplies. The Treasury buying price for domestic silver of 90.5c provided the point of balance. At any price below this level, supplies were reduced by the full amount of U. S. production; on the other hand when domestic production was needed, consumers had to pay more to bring such silver into the New York market, the exact price being determined by the shipping costs from the most distant delivery point drawn upon. Since the Treasury buying price of 90.5c applies equally whether the silver is delivered to the Philadelphia, Denver or San Francisco mints, consumers in the East are obliged to pay full shipping costs in order to divert the production of middle-western and far-western refineries to the New York market.

Under these conditions price fluctuations, while moderately frequent, were limited to a total spread of only 1⅝c per ounce. The low for the year of 90c was established on Jan. 23, and less than a month later the high of 91⅝c was reached. These prices refer to the New York published rate which is the price paid in settlement for silver in unrefined silver-bearing materials and is ¼c below the selling price for refined bullion. The market did not hold at either extreme for more than a few days and in fact did not again reach either the high or the low for the rest of the year.

The only exception to this basic pattern occurred in the fourth quarter, when consumers, for the first time since October 1955, found it necessary to buy silver from the Treasury to fill their needs. Under authority of the Act of July 31, 1946 the Treasury made silver available to U. S. consumers out of its non-monetized stocks, generally referred to as free silver. The selling price has been established at 91c per fine oz for delivery at the San Francisco Mint; and 91c plus the equivalent of railway express charges from San Francisco, or effectively 92.¼c, at the New York Assay Office. Since the trucking rate to New York from the West Coast for silver in bulk is lower than the railway express rate, purchases were made at San Francisco, and on this basis the price was published in New York at 91⅜c per oz.

For six weeks, consumers were more or less regular buyers from the Treasury. The first Mint purchase was made on Oct. 17, and the last on Nov. 28. Altogether the Treasury sold 3.7-million oz, equivalent to about one-quarter to one-third of the market's requirements during this period.

There were several factors which led to the need for Treasury silver, no one of which was particularly significant in itself, but all of which together brought about a shortage of silver available for prompt delivery. The blocking of the Suez Canal delayed shipments of silver to London from Australia, which is an important source for that market, and London buyers accordingly began looking to other centers, including New York, for additional metal. Meanwhile a strike in Peru at the Cerro de Pasco refinery further curtailed supplies, and at the same time deliveries to the New York market were temporarily reduced because of a two-weeks shutdown at one of the major refineries. These developments came just at the time of a moderate seasonal increase in trade demand both in this country and abroad. The result was that consumers had to turn to the Treasury for a portion of their needs. By the end of November the situation had eased, and buyers

U. S. Trade in Silver

(Millions of ounces)

	1956	1955
Imports:		
Canada	**19.8**	21.2
Mexico	**19.2**	21.5
Peru	**11.7**	10.9
Bolivia	**5.4**	3.0
Cuba	**.2**	.4
Other Western Hemisphere countries	**4.2**	4.0
Total Western Hemisphere	**60.5**	61.0
United Kingdom	**65.6**	.1
Netherlands	**19.3**	16.8
Other European countries	—	—
Japan	—	—
Australia	**11.6**	1.6
All other countries	**3.9**	5.0
Total Imports	**160.9**	84.5
Exports:		
Mexico	—	1.5
United Kingdom	**2.5**	.6
Western Germany	**.6**	1.9
All other countries	**1.9**	.8
Total Exports	**5.0**	4.8

U. S. Lend-Lease Statistics

(Millions of ounces)

Country:	Original obligation	Estimated total returns through Dec. 31, 1956	Estimated balance due Dec. 31, 1956
India and Pakistan	**226.0**	.0	226.0
United Kingdom	**88.1**	65.6	22.5
Netherlands	**56.7**	47.4	9.3
Saudi Arabia	**22.3**	.0	22.3
Australia	**11.8**	10.0	1.8
Ethiopia	**5.4**	.0	5.4
Belgium	**.3**	.3	.0
Fiji Islands	**.2**	.0	.2
Total	**410.8**	123.3	287.5

again were able to satisfy their requirements without recourse to the Treasury. The market, however, continued to absorb all domestic as well as foreign production, and the price remained unchanged at 91⅜c through Dec. 31.

Legislative developments. During the first session of the last Congress, a bill, S. 1427, providing for the repeal of existing silver legislation, was introduced in the Senate.

Lend-lease silver returns increased sharply in 1956 with the approach of the April 1957 due date. Of the total of 94.9-million oz received, the United Kingdom returned 65.6-million oz, the Netherlands returned 19.3-million and Australia returned 10-million. In the cases of Ethiopia, Saudi Arabia and 100-million oz of India's obligation, an extension of two years is permitted by mutual agreement. (see table.)

Treasury free silver stocks increased during 1956 because of lend-lease silver returns. At Dec. 31 they amounted to 87.4-million oz, up 62.5-million from the end of 1955.

World consumption of silver over the past several years has exceeded production by substantial amounts. However, the consumption figures include the amount used for U. S. coinage, which has not been part of the market demand. Eliminating U. S. coinage from consumption figures for the past five years, it would appear that production has exceeded effective demand by an average of about 12-million oz per year.

Outlook. United States silver laws and policy remain the controlling factors in the silver market. So long as the law provides a fixed price which serves as a minimum for the output of the second largest producing country in the world, and so long as the Treasury's selling policies remain unchanged, it seems probable that the silver market will continue in the pattern of the year just ended.

It is impossible to predict with any certainty what legislative action Congress will take during 1957. If the existing silver laws should be repealed, the Treasury would no longer be obliged to buy U. S. production and would have no authority to sell silver except at $1.29 per oz. Under these circumstances the market price of silver would fluctuate more widely and more frequently than it has in the recent past. Furthermore, it is probable that unless there were a substantial increase in demand, the average price level would be lower•

Treasury Silver

(Millions of ounces)

	Dec. 31 1956	Dec. 31 1955	Dec. 31 1954	Dec. 31 1953	Dec. 31 1952
Held in Treasury:					
Securing Silver Certificates:					
Silver bullion	**1,708.4**	1,697.2	1,679.2	1,655.7	1,631.7
Silver dollars	**182.8**	196.1	207.0	215.2	223.8
Subsidiary coin	**2.0**	11.3	34.5	4.6	2.8
Free silver bullion	**87.4**	24.9	13.6	49.6	81.7
Total Treasury stocks	**1.980.6**	1.929.5	1,934.3	1,925.1	1,940.0
Outside the Treasury:					
Silver dollars	**195.1**	182.0	172.5	164.9	156.6
Subsidiary coin	**967.7**	928.3	898.9	877.5	837.7
Total silver outside the Treasury.	**1,162.8**	1,110.3	1,071.4	1.042.4	994.3
Total silver	**3,143.4**	3,039.8	3,005.7	2,967.5	2,934.3

World Silver Statistics

(Millions of ounces)

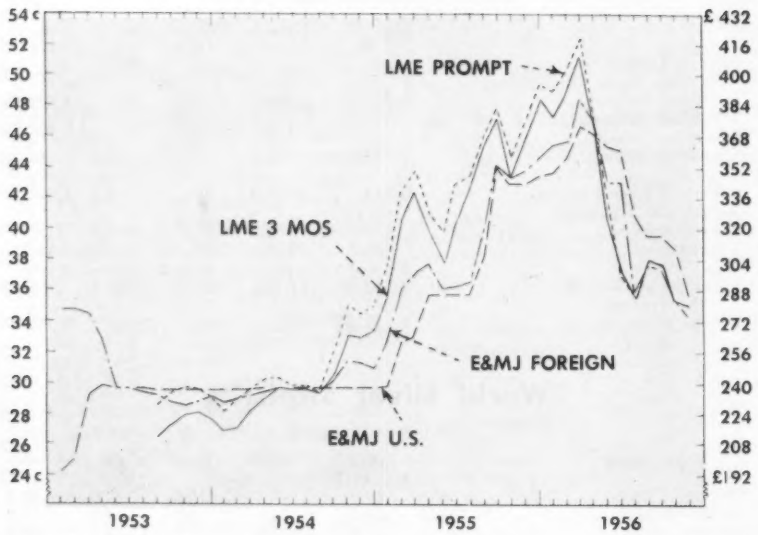
Production	**1956**	1955	1954	1953	1952
Mexico	**44.0**	48.0	39.9	47.9	50.4
United States	**37.5**	36.5	35.6	37.7	39.8
Canada	**27.5**	27.9	31.1	28.3	25.2
Peru	**23.0**	23.0	20.4	19.7	18.4
Bolivia	**7.0**	5.9	5.0	6.1	7.1
Other South and Central American countries	**6.0**	6.1	7.7	9.4	7.4
Total Western Hemisphere	**145.0**	147.4	139.7	149.1	148.3
Outside the Western Hemisphere	**85.0**	74.1	73.3	72.1	67.0
World production	**230.0**	221.5	213.0	221.2	215.3

Consumption	**1956**	1955	1954	1953	1952
Arts and Industries:					
United States	**100.0**	100.0	85.0	105.0	95.0
Western Germany	**40.8**	31.5	24.2	11.9	10.4
Great Britain	**13.0**	14.0	12.2	11.9	9.1
France	**12.0**	11.0	15.0	14.5	10.5
Japan	**8.0**	6.2	5.8	5.6	3.5
Canada	**4.5**	4.4	3.9	4.7	3.8
Other countries	**26.0**	12.0	11.3	14.7	9.8
Total	**204.3**	179.1	157.4	168.3	142.1
Coinage:					
United States	**31.1**	8.2	53.2	42.8	57.3
Saudi Arabia	**—**	17.2	—	—	23.0
Western Germany	**2.3**	.1	.3	3.3	14.1
Mexico	**4.9**	2.3	—	18.6	7.1
Canada	**2.8**	.5	.9	3.8	3.0
Other countries	**15.0**	15.0	23.7	22.3	9.8
Total coinage	**56.1**	43.3	78.1	90.8	114.3
Total consumption	**260.4**	222.4	235.5	259.1	256.4

Silver Quotations

	New York price (Cents)			London spot (Pence)		
	High	Low	Average	High	Low	Average
1956	**91.625**	**90.000**	**90.826**	**81.375**	**76.625**	**79.132**
1955	92.000	85.250	89.099	80.250	73.750	77.507
1954	85.250	85.250	85.250	74.375	72.000	73.482
1953	85 250	83.250	85.188	74.000	72.875	73.945
1952	88.000	82.750	84.941	77.000	72.500	74.360
1951	90.160	80.000	89.368	78.500	70.000	77.856
1950	80.000	71.750	74.169	70.000	63.000	64.796
1949	73.250	70.000	71.930	64.000	42.500	49.243

Copper Price Comparison in 1956



Monthly averages. London Metal Exchange prices, average of the mean of the bid and asked, refer to long tons; the two scales are equal at an exchange rate of $2.80 per £—£320 per long ton is 40c a lb. etc. Data through Nov. 1956.

Copper Statistics [a]

(Thousands of short tons)

	1956	1955
U. S. Output		
Mine	1,125	1,036
Secondary (b)	255	240
Secondary (c)	220	274
Refined	1,580	1,467
Imports (d)		
Ore, etc	125	126
Blister	272	254
Refined	190	202
Exports, refined	205	200
Stocks, producer	130	62
Shipments to fabricators	1,475	1,446
Shipments by fabricators (e)	1,430	1,314
Apparent consumption (f)	1,360	1,335
Actual consumption (g)	1,515	1,502
Fabricator stocks (end of yr.)	430	390
World		
Mine output	2,890	2,614
Refined output	2,990	2,728
Refined, del. to fabricators	2,830	2,744
Stocks, producer	355	221
Prices, per lb, in cents		
E&MJ com	41.818	37.491
E&MJ foreign	40.434	39.115

(a) Unless otherwise indicated, based on Copper Institute data. Most 1956 figures are based on data for first eleven months.

(b) From old scrap, unalloyed refined copper, based on Bureau of Mines data.

(c) From old scrap, alloyed copper, based on Bureau of Mines data.

(d) American Bureau of Metal Statistics.

(e) Estimates based on Copper Association data and exclude much product produced from secondary copper. Copper content of products.

(f) Based on data from U. S. Bureau of Mines. New refined copper withdrawn from total year's supply on domestic account.

(g) Based on Bureau of Mines data, which reflect actual reports by fabricators, foundries and chemical users.

Copper

George H. Cleaver
Market Editor

COPPER CONSUMPTION by U. S. industry remained well under refined production as 1957 began. This was the main problem facing copper companies at the beginning of the year. If this continues for another month or two, prices may be cut further and some firms, already unable to sell much of their output to industry, may be in a difficult situation. Some have filled their deliveries to the U. S. stockpile; others have recently increased their deliveries, and total monthly deliveries in the autumn of 1956 were rising. Most copper is now being sent into the stockpile at a lower price including escalation than the present market price of 34¾c to 36c.

Present copper problems differ from those of 1954 when a 10% decline in U. S. industrial activity was offset by a boom in Europe. Now Europe is down and U. S. activity is at record levels.

But some important copper consuming industries in the U. S., like residential building, appliances and automobiles, have not been sharing in the prosperity. If these industries continue low and others do not expand quickly, prospects for improvement by the copper producing industry are not good. Barring sizeable increases in industrial consumption outside the U. S. or further Government stockpiling, price declines may occur.

Many of the older copper producers undoubtedly can do well even if copper should return to 30c, but some of the newer operations may not. These apparently need a large output to get average costs down to a reasonable point. They may be unable to cut back and perhaps may even have to expand. In most cases Government purchase contracts will prevent losses.

A struggle for markets among copper sellers may be developing. Mine production outside the U. S. has been rising and new developments give prospect for large increases. The latter may have to reach high production rates to be economic. If the markets are not large enough, the laws of a free economy may decide who gets which markets and who produces how much, unless the Government steps in.

There are many devices by which it can step in but, national defense may no longer be an acceptable reason. This is especially the case since ODM "closed" the copper industry expansion goal in September.

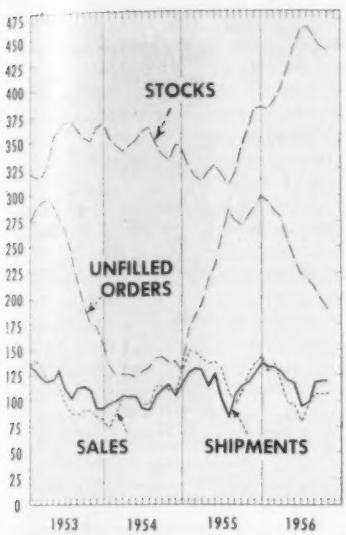
Most discussions of aid for the U. S. copper industry suggest exchanging U. S. copper for surplus agricultural products held by the U. S. Department of Agriculture. Copper selling firms would presumably arrange to sell the agricultural products abroad. This would involve dumping, antagonizing other countries. Objections have already been raised to U. S. barter of surplus agricultural products for foreign lead and zinc. Agricultural exporting nations like U.S. dumping of such products no more than the U.S. likes dumping in its own markets.

Such operations would probably mean U. S. firms would acquire foreign currencies, leading in turn to imports of foreign products. This might reduce foreign objections, but not much, and chances of the proposal being accepted by the U. S. Government do not look good.

Copper prices in 1957 are not likely to be as widely scattered as in 1956. At

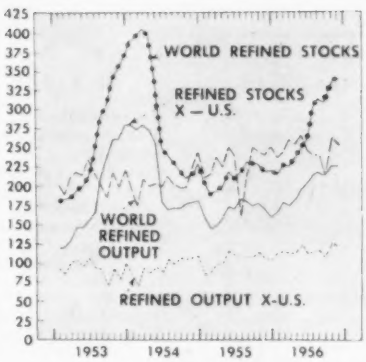
(*Continued on p. 98*)

U.S. Copper Fabricating



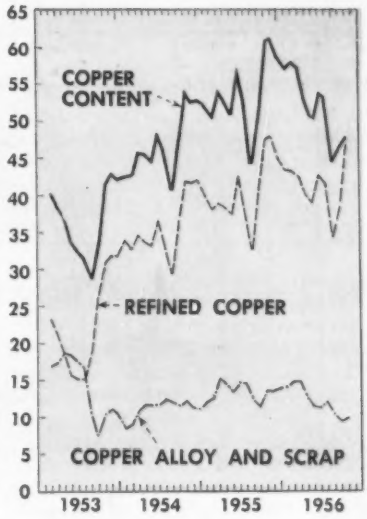
Two months moving averages in thousands of short tons. Based on U. S. Copper Association data. Through November 1956. All series are for fabricated products except stocks which are of refined copper.

Copper Output and Stocks



Statistics in thousands of short tons from the Copper Institute. World refined output and stocks exclude the USSR, Japan, the Scandinavian countries, Australia, Yugoslavia and the Messina Mine in the Transvaal. The two series "X—U.S." are the above world series exclusive of the U.S. Stocks exclude those held by fabricators. Data through November 1956.

U.K. Copper Fabricating



Data in thousands of long tons refer to copper content of fabricated products. Two months moving averages. From British Bureau of Non-ferrous Metal Statistics. Data through October 1956.

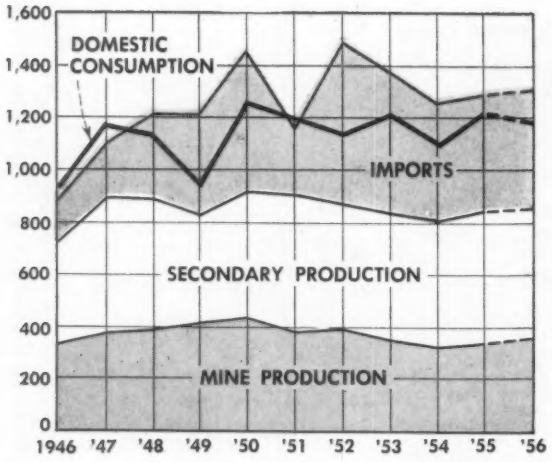
Copper Mine Expansion

(Thousands of short tons)

	Expansion	Annual full capacity
United States:		
1955		1,014
1956		1,130
1957	60	1,190
San Manuel (pre-1957 equalled 50)	20	
Berkeley	17	
Pima (pre-1957-3)	15	
White Pine	5	
Inspiration	3	
1958	36	1,226
Berkeley (1958-29)	4	
White Pine	5	
Ray	20	
Inspiration	7	
1959	11	1,237
Inspiration	8	
Anaconda (Mont.)	3	
1960 Anaconda (Mont.)	7	1,244
1961 Anaconda (Mont.)	34	1,278
1962		1,278
Outside United States:		
1955		1,968
1956		2,183
1957	132	2,315
Canada:		
Gaspe (pre-1957-30)	6	
Geco (start)	10	
Heath Steele	3	
Tilt Cove (start)	7	
Chile:		
Chuquicamata (pre-1957-25)	25	
La Africana	4	
Ireland: Avoco (start)	4	
Israel: King Solomon	7	
Nicaragua: Rosita (start)	1	
Philippines:		
Atlas (pre-1957-18)	12	
Sipalay	9	
Cobapa	1	
No. Rhodesia:		
Chibuluma (pre-1957-12)	6	
Bancroft (start)	24	
Kansanshi	5	
Kenya: Macalder, Nyanza	2	
Uganda: Kilembe (pre-1957-4)	6	
1958	76	2,391
Canada:		
Geco	8	
Tilt Cove	10	
Others	10	
Ireland: Avoca (completed at 13)	9	
Nicaragua: Rosita (completed, 5)	4	
No. Rhodesia: Bancroft	24	
Fr. W. Africa: Mauritania (start)	11	
1959	53	2,444
Canada:		
Gullbridge	6	
Brunswick	3	
No. Rhodesia: Bancroft	24	
Fr. W. Africa: Mauritania (completed, 22)	11	
So. Rhodesia: Molly	9	
1960	134	2,578
Chile:		
El Salvador (completed, 100)	100	
Potrerillos (minus)	—50	
Peru: Toquepala (start)	60	
No. Rhodesia: Bancroft (completed, 96)	24	
1961	74	2,652
Peru: Toquepala (completed, 120)	60	
Yugoslavia: Majdenpek	14	
1962	14	2,666
Yugoslavia: Majdenpek (completed, 28)	14	

Note: Cuajone and Quellaveco are schedules to come into production after 1962.

Lead Supply and Demand in the United States[1]



(Short tons)

	1956 estimated	1955
Supply:		
Domestic ores	350,000	338,025
Foreign ores and base bullion	203,000	177,479
Secondary	500,000	502,051
Net imports of metal	240,000	264,149
Total	1,293,000	1,281,704
Stocks at primary smelters and refiners	10,000[2]	51,028[3]
Total supplies	1,283,000	1,332,732
Demand:		
Industrial consumption	1,195,000	1,209,330
Consumers' stocks	10,000[2]	3,051[3]
	1,185,000	1,206,279
For stockpile and unaccounted for	98,000	126,453

[1] American Bureau of Metal Statistics, U. S. Bureau of Mines and Lead Industries Association. [2] Decrease. [3] Increase.

Lead

Robert L. Ziegfeld
Lead Industries Association

LEAD IN 1956 was featured by an extremely stable market, a good but not exceptional level of consumption, and a continued world oversupply which was taken care of by Government stockpiling. Domestic mine production increased slightly while secondary production remained constant. Imports of lead in ore increased considerably but imports of metal declined. Consumption was off, largely due to the lower rate of automobile production, but was still the fourth largest year of record. Late in the year the Government started bartering surplus agricultural commodities for lead for a supplemental stockpile in addition to its regular stockpile purchases.

Price. Except for a period of a few days in January 1956, the price was 16c per lb New York for the entire year. On Jan. 4 some sales were made at 16.5c and on the following day all sales were at that level. The price dropped back to 16c Jan. 13 and remained there.

Stockpiling. There can be little doubt that Government stockpiling was responsible for this remarkable stability. Purchases for stockpile under the program announced in 1954 which authorized purchases up to 200,000 tons of domestically mined lead, amounted to nearly 60,000 tons in 1956 and must have brought the total bought since 1954 close to the 200,000-ton level. In addition, the Government started bartering surplus agricultural commodities for foreign lead late in the year. The total amount of lead thus purchased for the supplemental stockpile is not definitely known but it is estimated that in excess of 30,000 tons were delivered in 1956 with considerably larger amounts already bought for later delivery. It has been estimated that U.S. Government stockpile holdings of all kinds exceed a year's lead consumption for both military and civilian requirements.

Production of lead in ores mined in the U.S. increased about 4% to about 350,000 tons in 1956, partly the result of freedom from major work stoppages. Secondary lead production remained constant and, at 500,000 tons estimated, was about equal to the preceding year. This again was near the record of 512,000 tons set in 1947.

Imports of foreign lead ores and base bullion were at an all-time high, increasing 15% over 1955 to a little over 200,000 tons. The bulk of imported ores came from Peru, South Africa, Canada and Australia. Imports of lead metal, on the other hand, again recorded a decrease. They amounted to an estimated 240,000 tons, off nearly 10% from the preceding year, and including the rather substantial tonnage already mentioned which was obtained for the supplemental stockpile by barter.

Total supplies, therefore, did not differ much from 1955 at about 1,293,000 tons, an increase of only about 1%. However, in 1955 there was a substantial reduction of producer's stocks which further added to total supplies while in 1956 producer's stocks increased slightly.

Consumption, as previously stated, was good but not a record. At about 1,195,000 tons it was off about 1% from 1955, yet was the fourth largest year on record, exceeded only by 1950, 1953 and 1955. As consumers' stocks fell 10,000 tons during the year, a little less than 100,000 tons of the total supply remained for stockpiling or was unaccounted for (see table). Figures given previously indicate that most of this tonnage went to stockpiles of one kind or another.

Consumption in the early part of the year continued relatively high with the momentum gathered in late 1955, and stockpile offerings were therefore minimal during the first few months. However, consumption was off during the summer, with fairly substantial stockpile offerings and the fall business, particularly in storage batteries, never reached the high seasonal expectations.

Uses. The year was disappointing in the largest lead consuming industry, storage batteries, which reflected the substantial set-back in automobile production. This accounted almost entirely for the reduction of about 15,000

tons, or 4%, of lead used for this product, resulting in battery consumption of about 365,000 tons. Normally with more cars on the road, using bigger batteries and being driven farther, one would expect replacement batteries to make up some of this loss. However, although it was estimated early in the year that battery consumption would increase, it never materialized. In fact, for the first 10 months of the year replacement batteries were slightly off at about 19.8-million. The only way to account for this is that batteries are being built to last longer. Practically all new cars are using the larger 12v battery, but the smaller 6v battery still predominates in the replacement field.

On the other hand, the second largest lead use, tetraethyl lead for gasoline anti-knock compounds, gave an exceptional account of itself and much more than offset the loss in battery business. Consumption there is estimated about 195,000 tons, an increase of approximately 30,000 tons or nearly 20%. The figure is more remarkable because of greater production abroad with a new plant going into production in Canada in the fall of 1956. A new plant also started production in California and plans have been announced for two other new plants; another in California and one in Illinois.

Obviously tetraethyl lead manufacturers have great confidence in the future growth of this product. There has been much talk about the gas turbine or free piston engine, neither of which would require high octane fuel, eventually displacing the conventional engine with its need for tetraethyl lead. The general feeling in informed quarters in both the automotive and petroleum industries seems to be (1) that wide commercial use of such engine is a long way off and may never take place, since conventional engines will also be improved, or (2) they will only be satisfactory for limited special applications like the diesel engine, which has been around many years and has never taken over the field.

Recent talk of fuel injection systems has also raised some conjecture as to their effect on tetraethyl lead if generally adopted. Such systems permit equal performance on gasoline of one lower octane number and, on the surface, would appear to reduce the need for tetraethyl lead. However, automotive engineers are anxious to get maximum performance, with the net result that compression ratios will be stepped up further where fuel injection systems are used and the amount of anti-knock ingredient used will be unaffected.

Lead Use in the U.S.[1]

(Short tons)

	1956 estimated	1955
White lead	17,000	18,549
Red lead and litharge[2]	80,000	87,503
Storage batteries	365,000	380,033
Cable	134,000	121,165
Building[3]	58,000	60,223
Tetraethyl lead	195,000	165,133
Ammunition	43,000	46,816
Foil	4,900	5,185
Bearing metal	27,000	34,567
Solder	73,000	88,749
Type metal	23,000	26,507
Calking	60,000	59,406
Other uses	116,000	115,494
	1,195,000	1,209,330

[1] Based on U. S. Bureau of Mines statistics. [2] Exclusive of oxides for storage batteries. [3] Chiefly pipe, sheet and extrusions. Includes lead used in chemical construction.

Third largest use of lead is in cable sheathing, which also gave a surprisingly good account of itself in 1956. Lead consumption increased from about 121,000 tons to 134,000 tons, more than 10%, probably the result of the huge utility expansion programs. Large amounts of lead-covered telephone cable were imported into this country in 1956, so the consumption figures for the U.S. do not reflect the total amount of lead-covered cable actually used.

Lead in solder showed a rather substantial drop of about 15,000 tons to 73,000 tons. This can largely be attributed to the lower automobile production which reduced the need for body and radiator solder and the fact that 1955 was an extremely high year for solder. Despite the lower rate of home building, lead used for building construction and calking lead showed little change, probably due to a compensating increase in other types of construction. Most other uses on which statistics are available showed moderate declines.

There are other applications of lead on which statistics are not separately available but which nevertheless are worthy of comment. An example is lead as a radiation shielding material. Growth in the shipping and use of radioisotopes has undoubtedly meant a growth in the use of lead for shipping, storage and handling of these products. The Navy Department's commitment to an atomic navy means substantial use of lead for shielding in the future. For example, a submarine may use several hundred tons of lead shielding and the Navy now has under construction or contract more than a dozen. Likewise larger ships use proportionately larger quantities. In industrial "hot" laboratories all sorts of lead shielded equipment are employed and some of this equipment, such as shielded industrial trucks, may have several tons of lead shielding on each. All in all this looks like a strong growth market for lead.

Outlook. The automotive industry expects a better year in 1957, production for that year being recently estimated as up 10% over 1956. So consumption of lead in batteries and solder should increase. On the other hand consumption of lead for tetraethyl can hardly be expected to show another phenomenal increase as it did in 1956. In fact opening of new catalytic reforming plants may temporarily have a reducing effect on the demand for tetraethyl lead. Cable sheathing may be expected to give a good account of itself, but the large increase shown in 1956 is not likely to be repeated. The huge Federal highway aid program should create an expanded market for red lead paint. Many states have already accepted the program.

On the supply side not much change is anticipated. Imports may increase, but this would be largely due to stockpile acquisitions through barter. There is of course uncertainty with respect to the extent of other stockpiling purchases in 1957, although Government officials have been making reassuring statements along this line. It should also be borne in mind that inventories of lead are low—in the hands of both producers and consumers.

For the distant future the outlook is also encouraging. No large new producing areas are in sight which would be likely to upset the supply picture. Recognizing that since World War II, lead production has exceeded industrial requirements with the over-supply being stockpiled, growth industries using lead should tend to close this gap. Further growth in batteries, tetraethyl lead and atomic shielding seems obvious. The trend to lower temperature firing in most branches of the ceramic industries indicates a growing use for lead compounds. Recent word indicates the superiority of litharge as a high temperature lubricant for jet engines and the like.

Against these expanding per capita uses, no major substitution for lead in other important applications appears imminent•

Zinc

Charles R. Ince
St. Joseph Lead Co.

THE INDUSTRY in 1956 established a new high in smelter production, experienced a consumption which was the second largest on record and exhibited a market stability never before encountered in its history. On the basis of good demand and a foreign market which rose above the domestic level, the price was advanced to 13.5c per lb early in January and was maintained there throughout the year. Although consumption fell off after the first quarter and did not revive until October—resulting in a continuance in the oversupply which existed the previous year—there was no weakening in the price structure as Government stockpiling absorbed the surplus. In addition to its regular domestic purchases, the Government about mid-year initiated the bartering of surplus agricultural commodities for supplemental stockpile purchases of foreign origin. This action was propitious as it came at a time when, due to the steel strike, consumption of the metal was more than could be absorbed by the current rate of the Government's regular program.

Consumption of zinc, while good by all but 1955 standards, was adversely affected by the steel strike and reduced automotive production as the industry's two largest customers—die casters and galvanizers—cut back orders. The decline in the brass industry also contributed its share to the drop. Per capita consumption of the metal at around 11.9 lb was consistent with the 1951 to 1955 average although the pattern of use has varied considerably from that of a quarter century ago. (See table.) While the over-all increase in per capita consumption of 16% in the last 25 years is encouraging, it is not at the rate which other competitive metals and materials experienced during the same period and is the subject of considerable activity on the part of the Industry Development Committee of the American Zinc Institute. In addition to its usual promotional programs, the Zinc Institute is just concluding a major investigation aimed at more effective use of zinc anodes for the cathodic protection of a wide variety of underground and underwater steel structures. It is also sponsoring research projects in the plating of die castings and the use of zinc oxide in paint formulations.

However, a study of the figures clearly indicates a "growth" industry in the use of zinc for die castings, the per capita consumption of which has expanded 350% in 25 years. While zinc-base castings experienced a temporary setback in its phenomenal growth with shipments at about 350,000 tons, which was 14% lower than the 1955 output, it was due to the fact that a 15% gain in non-automotive applications did not offset the more than 25% drop in shipments to the automotive industry which normally takes around 60% of the output of the zinc-base alloy. The American Die Casting Institute estimates that more zinc die castings are going into 1957 cars—the average increase being 8% over 1956 models. If 6.5-million cars are produced this year, as has been predicted, requirements for zinc for this application will be about 40,000 tons above the 1956 totals. Non-automotive applications, according to the American Die Casting Institute, should call for an additional 25,000 tons for such diverse end-uses as home appliances, industrial machines and tools, builders' hardware and office machines. A total of close to 420,000 tons of zinc should be required by the die casting industry this year, an increase of 20%.

Galvanizing, perennially the largest user of zinc, accounted for 430,000 tons—very close to the previous year's high. There is no doubt that this figure would have been exceeded if it had not been for the steel strike which suspended production of practically the entire industry for a period of 4 to 6 weeks. Despite this interruption, galvanized sheet shipments by the end of September were running 5% ahead of the previous year. However, consumption of zinc by the entire galvanizing industry was off due mainly to the drop in job galvanizing and the coating of wire, pipe, tube, etc. Use of zinc by the sheet and strip galvanizers, while up, was not commensurate with the increase in shipments of their product. Assuming shipments are synonymous with production over a period of time, a trend toward lighter coatings since the advent of the continuous galvanizing process might be indicated. In 1954, 153 lb of zinc were used per ton of galvanized sheet shipped. This figure dropped to 140 lb in 1955 and through October, the latest month for which figures were available at the time this article was written, had averaged 135.5 lb for 1956. This reduction could be accounted for by a more efficient use of the zinc in the galvanizing bath through reduction of drosses and other by-products or possibly by changes in the gages of steel sheet and strip galvanized. Furthermore, it is quite conceivable that if a thinner coat is being applied, the greater uniformity of the continuous-line product could provide

Zinc Balance Sheet

(Tons)

	1956 estimated	1955	Per cent change
Consumption	1,000,000	1,120,000	−11
Supply			
Smelter production	1,062,000	1,031,000	+3
Metal imports	230,000	196,000	+17
	1,292,000	1,227,000	
Less exports	9,000	18,000	−50
	1,283,000	1,209,000	+5
Surplus	283,000	89,000	
Distribution of surplus			
Refiners' stocks changed	+28,000	−83,000	
Consumers' stocks changed	−30,000	+19,000	
Shipments for Government account	250,000	87,000	
Unaccounted for	3%	6%	
Consumption by industries			
Galvanizers	434,000	451,000	−4
Die casting	352,000	431,000	−18
Brass	131,000	146,000	−10
Rolled zinc	48,000	52,000	−8
Oxide	18,000	22,000	−18
Other	17,000	18,000	−6
Total	1,000,000	1,120,000	−11

the same protection as the more irregular coating of the older types of galvanizing. The fact remains that the market for continuous galvanized sheet and strip is steadily growing and should continue to do so due to the unique nature of the product which provides a zinc coating as ductile as the steel base. A few of the present applications are: (1) general heating, ventilating and air-conditioning conduits (2) culverts (3) drainage pipes (4) roofing and siding (5) various kinds of formed containers. There were 34 continuous-lines in operation at the end of 1956 compared to 29 the previous year and 5 more were in the planning stage. This process now accounts for over 80% of galvanized sheet capacity.

The third most important user of zinc—brass mills—suffered from the uncertain situation in copper and a dependence on automotive production. The copper picture is being rectified by a greater availability and more reasonable prices, and with the expected good 1957 model year in cars, brass mills should recoup their 10% drop of last year.

Rolled zinc, French Process zinc oxide and miscellaneous uses of the metal registered a decline of 10%, about in line with the general drop in zinc consumption. No particular trends were indicated but the drop in zinc oxide can be attributed to lower new-car tire output as well as a lesser use in paints. In addition to the 18,000 tons of zinc metal used in production of French Process oxide, approximately 115,000 tons in the form of ore and other zinc-bearing secondary materials, were used for the production of American Process zinc oxide.

Average Yearly Zinc Consumption

	(Tons)		(Pounds per capita)		
	1951–'55	1925–'29	1956 estimated	1951–'55	1925–'29
Galvanizing	405,623	286,800	5.2	5.1	4.8
Brass and bronze	146,033	171,800	1.5	1.8	2.9
Zinc-base alloys	307,241	21,300	4.2	3.8	1.2
Rolled zinc	53,580	74,660	0.6	0.7	0.4
Other	34,712	53,300	0.4	0.4	0.9
Total	947,189	607,860	11.9	11.8	10.2

On the supply side domestic smelters including secondary production, turned out a record high of 1,062,000 tons of metal—more than sufficient to take care of the requirements of the domestic economy without metal imports. The latter amounted to 230,000 tons, 17% above the previous year and contributed largely to the surplus in supplies. The record high in smelter production was made possible by a moderate increase of 7% in domestic mine production to 540,000 tons, due mainly to freedom from work stoppages which occurred the previous year, and a record high of ore imports of nearly 530,000 tons metal content. Imports of ore and metal were again as in recent years in excess of domestic mine production and accounted for 60% of the supply.

Stockpiling continued to be a material factor in the zinc market throughout the year. Without this instrument of the Government it is hardly likely that the market could have supported the higher price which prevailed in 1956—roughly 10% above the 12.3c per lb average of the previous year. It is estimated that the Government through domestic purchase, bartering and deliveries under old Defense Minerals Production Agency contracts which are still running, removed around a quarter of a million tons of metal from the market during the past year. Although the information is "classified," available statistics indicate that the Government must have at least a year's supply of metal in stockpile at current rate of consumption. While the 300,000-ton additional objective announced in 1954 was apparently close to achievement at the end of 1956, reports from Washington indicated an upward revision in the long-term stockpile goals as well as a continuance of the bartering program. However, it is obvious that the absorption of surplus supplies by the Government cannot continue indefinitely and a day of reckoning must come. Consequently, producers and consumers alike await with interest the presentation to Congress of the long-term mineral program of the Administration which has been promised for early 1957.

Iron Ore

Verne D. Johnston
Consultant to Oglebay Norton & Co.

THIS LONG-RANGE FORECAST of potential iron ore requirements for the blast furnaces in the Great Lakes region is based on the B. F. Fairless estimate of Jan. 28, 1954, requiring 14 additional Fairless plants in 20 years, and the G. B. Homer estimate of May 1955 projecting the need for 185-million net tons of steel ingots by 1970 for total U. S. requirements. (Mr. Homer has recently raised his estimate to 200-million tons of ingots by 1971.)

Others who have made similar estimates include J. L. Mauthe, president of Youngstown Sheet and Tube Co.; P. D. Bloch Jr., president of Inland Steel Corp. and Charles M. White, president of Republic Steel Corp. Estimates by Messrs. Mauthe and Bloch were slightly more conservative than the Homer estimate. Mr. White's estimates were considerably more conservative, indicating a 170-million net ton steel ingot requirement by 1970. Recent trends show that capacity increases tend to follow the Homer projections.

Mr. Fairless indicated that he was merely illustrating how the increase in population alone could increase steel needs. Mr. Homer and others took into consideration both the increase in population and the per-capita usage of steel. Mr. Homer also has pointed out that the curve of increased steel needs has closely approximated increased national production of goods and services which was $370-billion in 1955, and is expected to reach $570-billion in 15 years.

Preparation of the accompanying chart required weighing the following variables: Basic estimates mentioned are for the entire U. S. in net tons of ingot capacities. To translate these into requirements for plants of the Great Lakes region, we must choose the steel plants which in the past have largely received their ore from the Lake

Superior district. Then, having determined the percentage that the Great Lakes region capacity is of the entire U. S., it is assumed that this ratio will continue into the future. Next we must estimate natural iron content in each of the ores to be used to determine how many gross tons of iron ore will be needed to make a ton of pig iron or steel, and how much the Lake Superior shipments may be retarded by incoming foreign ores. Finally, there is the possibility that steel production will reach the saturation point before the end of the 30-year period.

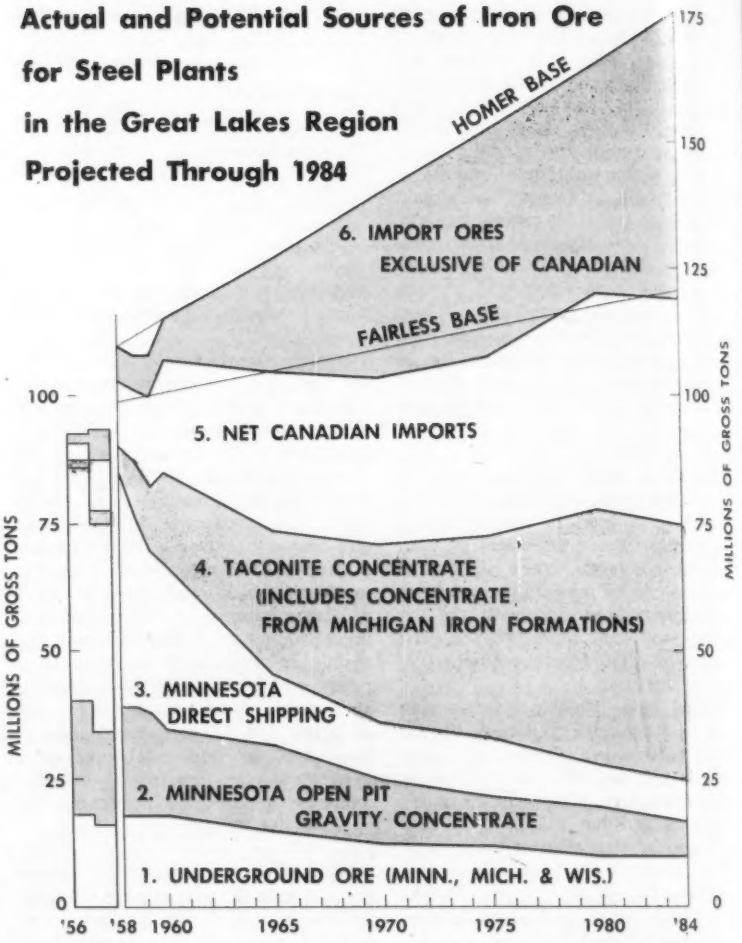
The accompanying chart differs from that published in *E&MJ* December 1955 in respect to shipments of direct shipping and gravity concentrate because more and more ore classified as direct shipping will be treated in washing plants. Likewise in the last five years of this chart taconite concentrate has been stepped up to 8-million tons yearly.

Since every large ore producer in the Lake Superior district has established a well-equipped research laboratory, it is entirely conceivable that commercial operations for the production of non-magnetic taconites will be established on the Mesabi Range within 25 years.

It is also probable that as initial large taconite producers perfect their processes, smaller units can be made commercial, such as Gunflint, small deposits on the Mesabi Range and a number of areas in Ontario now considered too small to develop. By the beginning of the next century shipments of taconite concentrate on the Great Lakes could rise to 60-million tons.

With the opening of the St. Lawrence Seaway, practically all of the import ore could be delivered via the Great Lakes. However delivery to the eastern seaboard and rail to Pittsburgh will be closely competitive, especially for American shipping. Pick up of ore at Seven Islands by foreign vessels, including Canadian, should result in cheapest transportation. Nevertheless, excluding much of the Seven Islands ore and Bethlehem's Marmora production, there should be an annual movement down the lakes of 90-million tons for 30 years or more. In addition, the 3.5- to 4-million tons yearly export to Canada would move on all the Great Lakes except Michigan.

With the completion of the seaway, many foreign vessels of all descriptions will be using all of the Great Lakes, and the best communication will be of essential advantage•



Explanation of Chart

LEGEND for six estimated major sources of iron for the Great Lakes region.

1. Shipments from underground mines of the Lake Superior district, U. S. This ore, known as direct shipping, needs no treatment except crushing of the coarser fraction to improve over-all structure.

2. Shipments of gravity concentrate, a beneficiated product from rich oxidized iron formation, treated by gravity and washing processes, without fine grinding.

3. Shows shipments of Minnesota open pit ores, direct shipping and not beneficiated except for structure by screening and coarse crushing.

4. Shipments of agglomerated concentrate produced from low grade (20 to 30% metallic iron) iron formations, known as taconite in Minnesota and jasper in Michigan. This treatment requires fine grinding and the product must be agglomerated to make it suitable for blast furnace use.

5. Net Canadian imports (imports less exports). In the early years direct shipping ores will predominate, but as time goes on, there will be increasing tonnages of gravity and agglomerated concentrates. Exports to Canada from the Lake Superior district, U. S., amounting to 4,029,000 tons in 1955, required vessel transportation.

6. Imports other than Canadian will largely be governed by the unpredictable increases in Canadian production. At any rate, there appears to be plenty of opportunities to meet all requirements in peace time of maximum expansion of the steel industry in the Great Lakes region. With the opening of the St. Lawrence Seaway, all Canadian imports to the Great Lakes region should be available for vessel transportation, and foreign ore can be delivered by foreign vessels.

Homer Base. Estimated ore requirements for capacity blast furnace operation.

Fairless Base. Estimated ore requirements for capacity blast furnace operation.

Magnesium

J. Donald Hanawalt
Dow Chemical Co.

THREE U. S. plants produced 67,500 tons of primary magnesium during 1956, continuing the same healthy relationship to consumption established in 1955.

Fabricating capacity also kept well ahead of increasing demand. In the wrought field especially, availability of products was increased both in scope and quantity. Installation of a 13,200-ton extrusion press at the Madison, Ill., plant of the Dow Chemical Co., means far bigger magnesium extrusions than ever will be available.

Applications. As in 1955, civilian uses for magnesium slightly exceeded military uses. Non-structural applications, such as alloying of aluminum, manufacturing of titanium, refining of nickel and cathodic protection, accounted for about 60% of total consumption. In the structural field, aircraft and airborne equipment was the largest market. Ground transportation, materials handling equipment, tooling plate, graphic arts and consumer products also were major users. Magnesium tooling plate continued to receive the exceptionally fine consumer acceptance it has enjoyed since its introduction in 1954 and was an easy winner for 1956 as far as growth rate is concerned. Sales increased threefold over 1955, with aircraft companies and automobile manufacturers the major users. Also, magnesium tooling plate won many new friends for the metal in other applications.

A strong upsurge in both interest and use of magnesium thorium-containing alloys for supersonic aircraft and missiles, and other applications operating in the temperature range 500 to 800 deg F, was another highlight of the past year. HK31A, Dow's first high temperature sheet alloy, was placed on a fully commercial basis. HM21XA-T8 and other developmental alloys which promise improved properties are being evaluated by Dow and customer firms. Market demand for high temperature magnesium alloys is expected to reach significant proportions in the next few years. At the same time, acceptance of standard magnesium alloys for military aircraft applications continued at a good rate. For example, magnesium comprises over 25% of the external skin of the Chance-Vought F8U-1 Crusader, which set a new U.S. speed record last summer. Over 300 magnesium castings are also used.

Magnesium luggage, introduced for the first time in 1955, consumed almost 2-million lb of sheet and extrusions last year—placing in a position to vie with ladders as the leading consumer application for magnesium.

Magnesium's already solid position in the graphic arts field was further bolstered during 1956 by the development and introduction of combination line and half-tone etch technique—which allows photographs and type matter to be engraved on the same magnesium plate. This refinement of the Dow Etch process is particularly well-adapted to the newspaper field.

The excellent machinability led to the first production-scale use of magnesium extrusions in the automotive field. Chevrolet now uses extruded magnesium stator blades in the manufacture of "Turboglide" automatic transmissions.

Two of the nation's largest producers of delivery trucks are now using magnesium in the new lightweight monocoque models. Encouraging results using the same design principle have also been achieved in van and flat platform-type trucks.

Significant advances are being made in military vehicles too. Extensive use of magnesium is anticipated during the coming year in the production of the Army's new "Mechanical Mule," a lightweight motorized platform developed by Willys Motors for carrying supplies over difficult terrain.

Magnesium sheet and extrusions for building concrete wall forms is another new application. Limited test data obtained to date indicate that magnesium forms may give 5 to 10 times longer service than wood.

Process developments. In the process development field, one of the 1956 highlights was the advancement of pellet extrusions from laboratory to production status. ZK60B alloy extrusions, made from pellet stock, are now being produced in volume at Dow's Madison mill—providing considerably higher compressive yield strength than standard billet-type extrusions in parts having a relatively large cross-sectional area.

Another processing development which reached commercial status during 1956 was the chemical milling of magnesium parts. That magnesium lends itself well to this relatively new metal-removal process is demonstrated by the Chance Vought Crusader's (mentioned previously) use of 106 chemically milled parts.

A highly significant technological advance of the past year was the discovery that high-purity aluminum (99.99%) and its alloys with magnesium provoke almost no galvanic attack when coupled to magnesium alloys, even in highly corrosive environments. This results from elimination of certain heavy metal impurities from the aluminum and is attended by an increase in the alkali resistance of the latter. Satisfactory application of high-purity aluminum coatings to magnesium and its companion metals and structures poses a difficult problem.

Production of higher-purity magnesium pig and ingot by the electrolytic process was announced in 1956. This means that metal ranging in purity to plus 99.9% is available in greater quantity to industry.

Magnesium thin-walled castings—in wall thicknesses ranging down to 1/10-in. with close tolerances—are now being used in production by several aircraft and missile manufacturers. One well-known surface-to-surface missile (the Chance-Vought Regulus) has an outer wing panel which is made as one integral casting. High-speed fighter planes such as the F7U and the F-102 use cast magnesium speed brakes.

In the finishing field, considerable progress has been made with the application of vinyl plastisols on magnesium. These tough, hard paints have excellent wear resistance and can be applied in considerable thicknesses in one coat.

Outlook. Domestic consumption of magnesium should set another peacetime record during 1957—about 78,000 tons. The gain should be split about equally between civilian and military applications and between structural and non-structural uses.

Cathodic protection, already one of the principal markets for magnesium, is expected to expand further during the next year. Biggest potential here is in the protection of marine ballast tanks and ship hulls.

Magnesium dry cells are expected to make their debut in the commercial market during 1957. Previous manufacture had been limited to military-type cells. Principal advantage of magnesium batteries is a high capacity (or energy output) per unit size and weight—both important in all portable lighting and electronic equipment•

U. S. Uranium Ore Reserves

(Measured, indicated and inferred ore, Nov. 1, 1956)

Area	Tons	Per cent U_3O_8	Per cent of total ore
New Mexico	41,000,000	0.24	68.4
Utah	7,500,000	0.34	12.5
Colorado	4,100,000	0.33	6.8
Arizona	2,600,000	0.30	4.3
Wyoming	2,300,000	0.22	3.8
Washington	1,500,000	0.18	2.5
Others	1,000,000	0.24	1.7
Total	60,000,000		100.0

U. S. Uranium Production

	1956	1955
Ore production (dry tons ore)		
January-June	1,340,000	
July-December*	1,660,000	840,000
Total	3,000,000	
Concentrate production (tons U_3O_8)		
January-June	2,600	
July-December*	3,400	1,600
Total	6,000	

*December estimated.

Uranium

Robert D. Nininger
U. S. Atomic Energy Commission

A NEW ERA for the uranium industry began in 1956. It now looks beyond the military market to the permanent, long range, industrial atomic power market.

Fortunately, the unhealthy speculative excesses of the "uranium boom" of 1953-54 sparked by the highly publicized prospector discoveries of 1952, during which the interest of speculators in penny stocks and unproved claims reached fever height, were short lived and had very nearly ended in 1955.

In spite of the hazards of prediction in this field, a fairly clear picture of the shape of things to come now seems possible. The uranium industry has developed a pattern similar to that of most of the metal industry. It has a full size range of operations, from the small independent mine, or group of small to moderate size properties supporting a local custom mill, to large tonnage, integrated mining and milling operations.

Ore reserves. Domestic ore reserves greatly increased during 1956, due primarily to further development of previous discoveries in New Mexico, Wyoming, Arizona and Washington. In December, measured, indicated and inferred reserves were estimated to be approximately 60-million tons. An additional potential of indefinite size, depending upon the period of time allowed for realization of potential discoveries and the economic assumptions used, may be estimated.

Development of the Ambrosia Lake district, northwest of Grants, N. M., was the outstanding event of 1956. The district was discovered in early 1955 and by June land acquisition and drilling became active.

Since that time, intensive drilling has expanded the boundaries of the district and is continuing to increase estimated reserves rapidly to the point where they represent a major portion of the U. S. total. The entire Grants area, including Anaconda's Jackpile mine, now represents nearly 70% of estimated total U. S. reserves.

Similar patterns of development, but on a smaller scale, have taken place in the Gas Hills and Crooks Gap districts of Wyoming, in the Monument Valley-Cameron district, northern Arizona, and in the northeast Washington area.

Notwithstanding this main trend, physical exploration in outlying districts away from the main producing areas is continuing, if on a less frantic scale. Among those districts in which discoveries were made are Lakeview, Ore.; the Pryor and Big Horn Mountains in Montana and Wyoming; the Gunnison area of Colorado; and the Texas Gulf coastal region.

There has also been continued activity in the lignite areas of North and South Dakota, although these areas have not yet indicated the potential originally anticipated after their discovery in 1954, and the metallurgical problems involved in economic uranium production from lignites have not yet been solved.

Ore production has increased rapidly. At the end of the year it had reached an annual rate of approximately 3.5-million tons and was expected to exceed an annual rate of 6-million tons within three years.

The number of producing mines and small shippers continues to grow. There were about 1,000 individual mining operations and 500 small shippers (less than 20,000 tons per year) in 1956 compared to 800 and 450 respectively in 1955. Many large and small mining operators have more than one operation.

Combined production of the small shippers in the first six months of 1956 was up 80% over that of the first six months of 1954. On the other hand, the major share of uranium production is now coming from the large deposits. Production from large shippers increased more than 300% during the same period.

Concentrate production. With the discovery of many uranium deposits, or groups of deposits, containing 1 million tons of ore or more, integrated mining and milling operations, suited to these larger deposits, have become more common. This is in contrast to the pre-1952 era, when important deposits were measured in the tens of thousands of tons. In several cases, joint milling operations have been undertaken by two or more companies having properties within an area, each company, however, retaining ownership of its deposits.

An example is the combination of Kerr-McGee Oil Industries, Pacific Uranium Mines Co., Ambrosia Lake Uranium Corp., and Anderson Development Corp., forming the Kermac Nuclear Fuels Corp. to mine and mill the ore of their large holdings in the Ambrosia Lake area.

In some cases, outright purchases have been made, such as the purchase of the Happy Jack mine in White Canyon, Utah, by Texas-Zinc Mineral Corp. However, in most cases, where such arrangements have been made to provide for larger milling capacity, the individual or small company whose ore is involved has retained partnership, participating or royalty interest.

In 1956 the U. S. was the leading uranium producer in the Free World. Concentrate production in 1956 was about 6,000 tons U_3O_8, increasing during the year from about 4,000 tons U_3O_8 annually, to more than 8,000 tons.

Capacities of U. S. Uranium Mills

(Dec. 31, 1956)

Company	Location	Capacity (Tons ore per day)
In operation		
Anaconda Co.	Bluewater, N. M.	3,000
Atomic Energy Commission	Monticello, Utah	600
Climax Uranium Co.	Grand Junction, Colo.	350
Kerr McGee Oil Industries, Inc.	Shiprock, N. M.	500
Mines Development, Inc.	Edgemont, S. D.	300
Rare Metals Corp.	Tuba City, Ariz.	250
Union Carbide Nuclear Co.	Uravan, Colo.	850
Union Carbide Nuclear Co.	Rifle, Colo.	280
Uranium Reduction Co.	Moab, Utah	1,500
Vanadium Corporation of America	Durango, Colo.	430
Vanadium Corporation of America	Naturita, Colo.	350
Vitro Uranium Co.	Salt Lake City, Utah	550
Total		8,960

Company	Location	Capacity (Tons ore per day)
To be completed in 1957 or early 1958		
Atomic Fuels Extraction Co.	Bedrock, Colo.	200
Dawn Mining Co.	Ford, Wash.	400
Gunnison Mining Co.	Gunnison, Colo.	200
Lost Creek Oil & Uranium Co.	Split Rock, Wyo.	400
Lucky Mc Uranium Corp.	Fremont County, Wyo.	750
Trace Elements Corp.	Maybell, Colo.	300
Texas Zinc Minerals Co.	Mexican Hat, Utah	775
Union Carbide Nuclear Co.	Rifle, Colo.	1,000*
Total		4,025

*Including ore fed to concentrating plants.

There were 12 operating uranium mills at the end of the year including the AEC-owned plant at Monticello, Utah. Investment in private milling facilities to date is estimated at $50-million. Contracts for the purchase of concentrates from eight new mills were negotiated in 1956. When these are completed in 1957 and early 1958 total investment will approach $100-million. Proposals for the purchase of production from six additional plants, some with capacities exceeding 1,000 tpd, are being considered by the Commission.

Metallurgy. Column ion exchange is now the most important uranium extraction process in the new mills being constructed throughout the world. Supplementing this process, the resin-in-pulp technique was developed to treat ores which are not easily filterable.

Most recent results of the AEC's process development activities have been a successful application of solvent extraction methods to recover uranium from leach liquors. Several mills are currently in operation or being planned using this technique in whole or in part.

Another recent development which appears to be ready for industrial use, is the recovery of uranium from carbonate leach liquors through the use of resins in a manner similar to techniques employed in the acid RIP system. Column ion exchange for carbonate liquors may also be an economic process. It is anticipated that carbonate leaching will be used on most Ambrosia Lake ores.

Government actions. AEC took the following actions during 1956:

1. Announced on May 24, 1956 its new procurement program for concentrates which provides a Government market for domestic uranium, subject to certain limitations on quantities, during the period 1962-1966, after the ore procurement program, begun in 1948, is due to expire. This lengthened the period during which mining and milling enterprises could be planned and financed and provided more stability for the industry.

2. Modified Circular No. 5 (Revised) which provides for the Government ore-buying program, extending until 1962, to eliminate accounting for the expenditure of the development allowance of 50c per lb of U_3O_8 content in ore by companies shipping in excess of 1,000 tons of ore per year.

3. Issued regulations providing for competitive bidding for leases on uranium deposits discovered by the Commission on withdrawn public lands. Because of the improved supply picture, it is expected that few leases will be offered for bid in the near future.

4. Declassified uranium production and ore reserve figures in December 1956, permitting the industry and those planning to use atomic power to plan for the future with better information on available supplies.

5. Terminated its aerial prospecting program.

6. Relinquished for restoral to the public domain the last of the public lands originally withdrawn for AEC exploration except for approximately 50 square miles on which deposits of sufficient importance to be leased were discovered at Government expense.

7. Accepted the proposal of the General Chemical Division of Allied Chemical & Dye Corp. for the production of 5,000 tons U_3O_8 equivalent per year as highly purified uranium hexafluoride (UF_6) from crude uranium concentrate. Heretofore all refining steps beyond the initial concentrate stage have been carried out in Government owned plants operated by AEC contractors.

8. Extended the bonus for initial production of uranium provided for in Circular No. 6, to March 31, 1960.

9. In December, the French Atomic Energy Commission revealed its projection of uranium production to be 380 tons of uranium content in concentrates in 1957, gradually increasing to 3,000 tons in 1975. The French announced reserves of 50,000 to 100,000 tons of uranium.

Foreign developments. Production has been steadily increasing in Canada and South Africa, two of the major producers, and successful exploration, development, and production programs continue in the Belgian Congo, France, Portugal and Australia. Exploration, in its early stages, is also going on in Latin America, particularly in Peru, Argentina, Colombia, Brazil, and Chile, and you may expect significant production in the future from some of these countries.

Uranium developments in Canada have followed a pattern similar to that of the U. S. Primary attention is now directed to the development of known deposits for mining, primarily in the Blind River, Beaverlodge, and Bancroft areas, rather than to the discovery of new deposits.

Mills under construction, or for which Government contracts have been negotiated, in the Blind River district alone, have a scheduled capacity of more than 30,000 tpd, and reserves have been estimated at more than 100-million tons of relatively low-grade ore. Approximately $175-million has been spent or committed in development and mill construction in the Blind River district alone to date and the figure continues to grow.

Canada announced, in December 1956, total estimated reserves of 225-million tons of ore containing 238,-000 tons of uranium.

Rio Tinto Mining Company of Canada by merger with the Joseph Hirschhorn interest, in 1956, obtained control of a major part of the Blind River district. Rio Tinto is also developing the Mary Kathleen deposit near Mt. Isa, Queensland, Australia, and has a contract with the United Kingdom for the sale of more than £40-million worth of production.

The Radium Hill, South Australia, and Rum Jungle, Northern Territory, operations in Australia produced at capacity during 1956.

Completion of new processing plants in South Africa was also announced during the year. Sixteen mills of a total of 17 approved have been completed and will treat in excess of 20-million tons of tailings annually from 27 gold mines.

Exploration. Changes in the uranium supply situation caused modification of the AEC's exploration program.

In 1955, total Government drilling was little more than one-half million feet as compared to an estimated more than 5-million ft by private industry. Government drilling ended in the first half of 1956 during which time only 40,000 ft of hole was drilled.

A continuing re-orientation of the AEC's exploration program to make it consistent with present needs is resulting in quite a different type of program from that in the past.

The AEC exploration staff will evaluate private exploration and development activities, and develop ore reserve and production estimates, in order to provide information for Commission planning in direct support of the current procurement program. In addition to information related to the current procurement program, this staff must also evaluate the potential supplies that may be available for the future atomic energy program. Such a program can be carried out by a staff of moderate size, substantially smaller than the exploration organization built up during 1948-1955•

Titanium

George P. Lutjen
Managing Editor

RECORD SALES, record production, new price lows, were only part of the 1956 accomplishments of an aggressive, growing titanium metal industry. New plants, new methods came into being and perhaps a continuous process substitute for the Kroll process came a little closer to actuality.

Sponge production zoomed. Take a look at the curve. Sponge production for 1956 is estimated at 14,500 tons by T. W. Lippert, sales manager of Titanium Metals Corporation of America. About 10,000 tons of this, to which was added some 1,500 tons of alloying metals and recycled titanium scrap, went to the fabricators. The remaining 4,500 tons wound up in the hands of the Government or in the plant inventories.

Leading sponge producers were Titanium Metals Corporation of America (TMCA), E. I. du Pont, Electro Metallurgical Co., Cramet, Inc., and Dow Chemical Co. During the year Republic Steel purchased a half interest in Cramet's Chattanooga sponge plant which is being brought up to its full capacity of 6,000 tons a year. According to Cramet engineers, research now in progress "could further raise capacity considerably beyond." TMCA is also planning increases.

National Distillers Products Corp. expects to have a 5,000-ton a year plant in operation at Ashtabula, Ohio, by late 1957. Sponge will be made from $TiCl_4$ using sodium as a reducing agent.

Although today's production is all by basically Kroll process, many companies are investigating other approaches. Horizons Inc., for example, has a contract with the Navy Bureau of Aeronautics for development of a "somewhat revolutionary and potentially very economical method for direct production of high quality titanium metal. Feed materials . . . will consist of 'metallic-like' materials containing high percentages of titanium. This class of materials may be prepared readily by high temperature procedures, and early indications are that certain of these may be suitable as a feed material to a fused salt electrolytic process. Purification of the 'metallic-like' material is effected by selective electromotive transport from anode to cathode."

National Research Corp. started a 1,000-lb per day pilot plant to study a fused salt process. The high purity crystalline product has a hardness well below 100 Brinell but the economics of the process will not be known until pilot operations are complete in the first half of 1957.

Vice president C. H. George of New Jersey Zinc reports, "We have diligently carried on our research of ductile titanium metal by fused salt electrolysis. We are making encouraging progress."

And out at Boulder City, Nev., the USBM dismantled its Kroll pilot plant to make way for a semi-commercial, 10,000 to 20,000-amp electrolytic cell based on a 4,000-amp prototype.

Stauffer Chemical Co. has been quietly piloting a titanium process which may use thermal dissociation. About the only published fact is that $TiCl_4$ is the starting material. This entry into metal production is a departure for Stauffer which seemed content to furnish $TiCl_4$ to other sponge producers. In fact in 1956 they doubled the capacity of the tetrachloride plant at Niagara Falls and started building a new plant at Ashtabula to supply National Distillers.

Just under the wire as the year ended was the announcement that Kennecott Copper Corp. and Allied Chemical & Dye Corp. plan to invest $40-million in a jointly owned company to produce and sell titanium. Where the plant will be built and what process will be used remain undivulged.

Sales—How high is up? According to Lippert, more than 5,000 tons of mill products (billet, bar and sheet) were sold for a healthy $130-million. This meant that the going price average for fabricated titanium was about $13 per lb.

One headache for the salesman was delivery, which still lags from 8 to 14 months behind the order. What was worse, some types of material were completely unavailable; foil, for instance.

Melting and processing of titanium metal was largely in the hands of four companies; TMCA, Rem-Cru Titanium, Inc., Mallory-Sharon Titanium Corp., and Republic Steel Corp. The latter's purchase of half interest in Cramet's Chattanooga sponge plant gives the industry its second integrated producer. The other is TMCA.

Two more companies got started in 1956: Oregon Metallurgical Corp., will melt ingots at Albany, Ore., and Harvey Machine Co., started ingot furnaces to melt extrusion rounds at Torrance, Calif.

Trends in melting and processing include increased interest in casting and in the use of larger ingots. Skull melting has received attention for its versatility as a possible substitute for the conventional cold mold consumable electrode arc melting method. The hope is for production of homogeneous, multi-constituent alloys without double melting and at least one melter has a unit on order.

First plant for rolling and forging titanium on especially designed equipment will be reconstructed from a steel plant in Toronto, Ontario which TMCA purchased late in the year.

Horizons meantime, is studying the possibility of direct extrusion of electrolytically produced titanium metal powder. Process yield is said to approach 100% with virtually no scrap loss.

Scrap is still a problem. Simple arithmetic shows that 11,500 tons of metal went into the production of little better than 5,000 tons of fabricated products. What became of the rest?

This outside scrap problem received a lot of attention in 1956. Mallory-Sharon is putting up $500,000 for a pilot plant to test an electrolytic process for recovering titanium from scrap. Horizons Inc., wound up a scrap recovery development program under contract with GSA which "culminated in the successful development of an economic method for conversion of titanium scrap to extremely high quality titanium metal powder. The process . . . consists of charging impure scrap in an anode chamber of an electrolytic cell and selectively electrodepositing high purity titanium on a metal cathode. A carrier electrolyte of NaCl containing Ti ions constitutes the bath."

Prices dropped drastically. In May, TMCA dropped the sponge price from $3.45 per lb to $3.25. On July 2, du Pont knocked off another 25c and again on Dec. 5, to bring the price to $2.75.

Mill product prices were lowered 6% by TMCA in May and again in December. This may well be the pattern of price changes that will hold for the future; integrated companies like TMCA and Republic-Cramet lowering the fabricated price and sponge producers lowering the sponge price.

With an average sales price of $13 over 1956 for fabricated products, profits on sales of fabricated material were probably in the neighborhood of $3.25 for the industry as a whole. The estimate is Herbert Kellogg's, head of ODM's Titanium Committee, and it was made at AIME's Fifth Titanium Symposium in Cleveland in October.

Raw material source of titanium metal industry, continues to be rutile from Australia, but most companies are looking for a hedge against the day when this supply may not be up to demand. Some are thinking in terms of upgrading ilmenite. Others are scouting for new rutile sources. Heavy Minerals Co., a subsidiary of Crane and Vitro Corp., has developed a rutile deposit in Aiken County, S. C., and Republic is exploring deposits in Mexico.

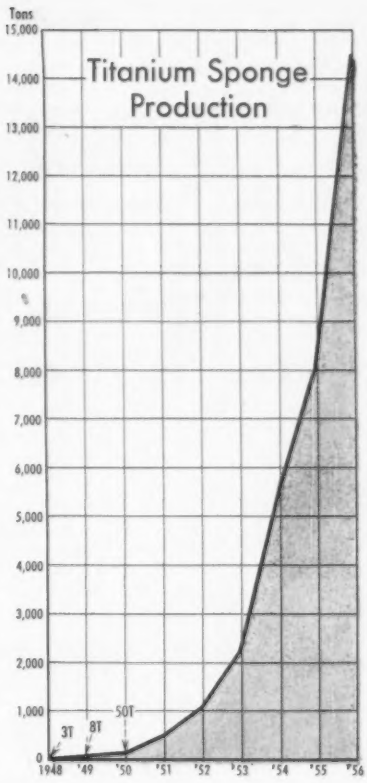
Quebec Iron and Titanium Corp. mined 564,000 gross tons of ore at its Lac Tio mine for its plant at Sorel, Quebec. Most of the titanium-bearing slag produced was shipped to the U. S. pigment industry, but QIT also reported "there is a developing demand for slag from titanium metal producers."

And New Jersey Zinc, part owner of QIT, is "operating a 5 tpd pilot plant to demonstrate the economics of our patented method for production of $TiCl_4$, particularly from Sorel slag. This work will be finished in a few months."

One development not reflected in the statistics, is the growth of the service of Battelle Memorial Institute as a clearing house for information on all aspects of titanium. This was set up as a Government contract in 1955. To date over 21,000 documents (reports, articles, patents, books) containing technical information have been received and processed into the Institute's files. Anyone concerned with titanium in any way would do well to check here for any information needed. Get in touch with the Titanium Metallurgical Laboratory in Columbus, Ohio.

While opening this channel of communication has been a step in the right direction, a serious holdback in titanium development has taken place because many of the companies refuse to divulge information of a non-proprietory kind. This includes such items as properties of simple alloys. The net result is a great deal of duplication of effort as each company does its own testing.

Outlook for the titanium metal industry is one of unabashed optimism.



J. Shrawder, Jr., of du Pont, sums up the consensus: "The great bulk of production is going into the defense aircraft industry. This movement will undoubtedly continue, and at an accelerated pace, in 1957. However, the long-term health of the business seems to us to demand the development of solid civilian applications based on the unique properties of the metal."

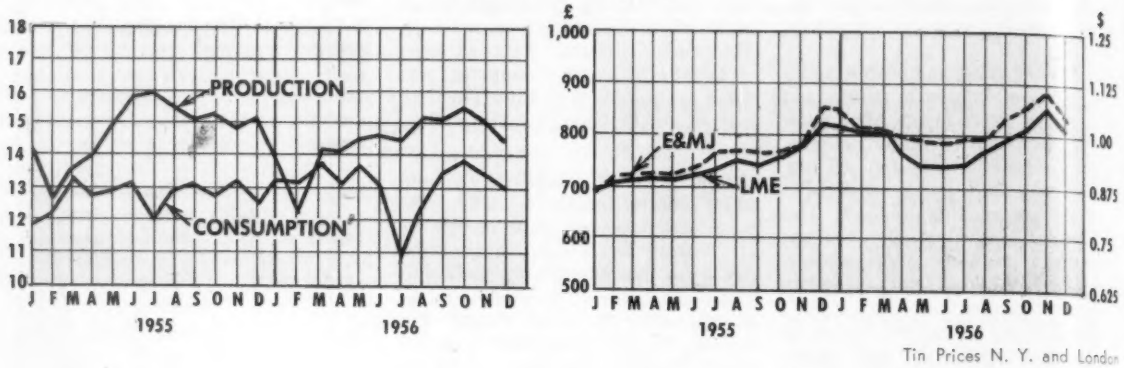
Foremost among Mr. Shrawder's "unique properties" is titanium's corrosion resistance and much effort is going into research along this line.

And Republic cites another augury: ". . . the use of an all-titanium body in the General Motors experimental auto, Firebird II . . . While present cost of titanium prohibits its wide use in production automobiles now, it is encouraging to see the start of an evaluation program in the automotive industry. Use of titanium alloys in bar form at high strength levels along with low density and extreme toughness, suggest further fields of exploration in the internal combustion engine."

In sum, 1957 should see much progress, particularly if communication among industry members can be stepped up; prices should drop further though probably not as sharply as in 1956; and production could double•

World Tin Production and Consumption

(Thousands of long tons)



Tin

J. R. O'Connell Jr.
Assistant Market Editor

THE PRICE of tin will rise and fall with the shifting international situation in 1957.

Tin market followers, in the year ahead, will focus on five locales: 1. Texas City, Tex. 2. Washington. 3. Suez. 4. Malaya. 5. London.

The Texas City tin smelter, formerly owned by the Government, posed the major uncertainty in the tin market in 1956, and continued to hold attention as the year ended, when Wah Chang Corp. purchased it.

The plant was originally scheduled for shutdown June 30 1956. However, Public Law 608, approved June 22 extended the authority to operate the smelter until Jan. 31 1957, and authorized disposal of the unit at that time.

Negotiations were completed shortly before the end of the year. The smelter was sold to Wah Chang Corp. for $1,350,000 with a clause that could mean as much as $2-million additional for the Government, depending on the success of operation. Spokesmen for Wah Chang said that part of the plant will be adapted to tungsten and manufacture of tin alloys and that a substantial portion of the facilities will be maintained for tin smelting. No statement as to the amount of tin metal to be produced has yet been issued.

Market observers feel that tin production will be entirely subordinate to tungsten operations. Two-thousand tons of tin is considered a maximum possibility. Bolivian and Indonesian ores, previously sent to Texas City, are now being sent to the U. K. A thought prevades that terms of the sale may have included a stipulation by the Government that the new owner be prepared to swing into full tin operation in the event of a world crisis.

Tin production at the Texas smelter in 1956 was 17,631 tons. In 1955 it was 22,239 tons. All of this production has gone to the U. S. stockpile. The world market can therefore expect a surplus of about 20,000 tons of tin in 1957. World tin metal output and consumption were in near balance at the close of 1956. Many tin observers believe that the 1957 excess may not be as high owing to increased consumption, and look for a maximum possible surplus of no more than 10- to 15,000 tons. Production in 1957 is likely to remain at the 1956 level.

Primary Tin Statistics

(Long tons)

	1956	1955
World mine output(c)	173,000	177,000
World consumption	156,000	154,000
World stocks:		
Gov'ts included	(a)393,000	(a)376,000
Gov'ts excluded	(b) 70,000	(b)65,000
U. S. consumption	60,300	60,700
U. S. import (pig)	58,500	64,500
U. S. output (pig) at Texas smelter	17,631	22,327
Price, av., N. Y. prompt	101.409c	94.735c
Price, av., London, cash	£787.7	£740.1

(a) This estimate was arrived at by adding to the International Tin Study Group figure for the end of 1947 of 135,000 tons, the excess output over consumption each year. (b) I.T.S.G. figure. (c) Excludes U.S.S.R.

In Washington as 1957 commences, the question of U. S. Government stockpile policy concerning tin arises. An Office of Defense Mobilization ruling authorized purchase of the metal through June 30, 1957. It is unlikely the Government will buy tin on the open market. Previous policy was to keep at least three years' supply on hand. This amount has long since been reached. Tin market followers believe the U. S. tin stockpile is adequate for at least 10 years, though official totals are classified. The State Department's desire to maintain close relations with Bolivia and Indonesia would probably be a factor in further tin purchases.

The trading of surplus U. S. farm goods for strategic stockpile commodities was stepped up in 1956. ODM lists tin under materials suitable for barter, but it is unlikely tin will be obtained in this manner, since the U. S. Government stockpile is more than adequate.

In Suez, trouble, which threatened in 1955, materialized in 1956. The world tin market will react violently to the slightest political disorder in 1957. Renewal of fighting would offset all other market factors.

Tin, which is normally transported to Europe and the U. S. via the Suez Canal, will continue to be re-routed around the Cape and through the Panama Canal for as many months as Suez clearing operations require. First guesses were for as long as a year. With work underway, it now appears that clearance will be accomplished in three to six months. Until cleared, emergency shipping schedules and resultant costs will plague shippers.

A supply pinch did not materialize. Scare buying, which naturally accompanies any war threat, pushed the London market up sharply. The U.S. price followed, but had eased as 1956 closed. Suez trouble has and will continue to cause uncertain schedules, but does not mean that shipments from Malaya and Indonesia will falter. The ability of shippers to handle the re-routing task is an important consideration in assaying the price level tin will seek in the first quarter.

In Malaya, labor problems occurred regularly in 1956. They appeared to be in line with complaints of other working groups in Africa and the Orient. Nasser, Nehru and anti-colonialism have sparked individual worker interest. Continued strike threats can be expected in 1957. A full-scale general strike for 1957 is not in the picture at present, but it is not out of the question. Market men will watch Malaya intently, trying not to be bluffed by strike threats.

A strike at the Butterworth smelter in Penang, Malaya, early in January 1957 was the year's first outbreak. Ores usually smelted there were sent to Singapore to be processed. The strike involved 300 men, but did not hurt production. World prices firmed slightly as a result. Danger in 1957 will lie in sympathy strikes. The Malayan laborer lacks the support given to U. S. workers, and cannot afford the loss of many days' pay.

In London, the International Tin Agreement which was still only an idea in 1954, and a plan in 1955, took shape in 1956. If required, it stands ready to test its ability in 1957.

What is the purpose of the Tin Agreement? It is essentially a price control arrangement, whereby the price of tin may be maintained at a desired level by altering the amount of metal available in the world market.

How does it work? Through a system of buffer tin stocks and cash deposits contributed by 15 producing and consuming countries, the Agreement, under the auspices of the United Nations, will buy or sell tin on the world market as the situation demands. For example—should prices fall, the Agreement would buy and stock tin. Were the supply to dwindle, forcing prices up, buffer stocks would be sold on the world market in order to bring about a balance of supply and demand. (G. H. Cleaver in the Feb. 1956 *E&MJ* Survey & Outlook discussed the pros and cons of such control.)

It is felt that extension of Texas City smelter operations until January helped the Agreement by providing time to organize before facing a possible problem of world surplus.

Contributions from each producing member were due by Dec. 15, 1956. These consisted of either metal or cash at the rate of £640 a long ton totaling 25,000 tons. The bulk of initial contributions was in cash, so that the market would not be deprived of metal, and also to take advantage of high market prices. Thailand was the only producing country that did not ratify the Agreement.

The Agreement also lacks the membership of the United States, the world's largest consumer of tin. Many feel that the organization cannot survive over a period of time without U. S. support. As a short-term control, the Agreement is well received. Whether the less stable economies of some of the member nations would permit a full-scale production cut in event of an emergency, is a major problem faced by the group. Some countries cannot afford to tie up their money and metal over a long period.

When the LME price is equivalent to 90c a lb or less, the manager has the option of buying on the world market. At 80c he must take action. At $1.00 or more he may sell and at $1.10 he must sell. All are subject to revision.

Any buying by the manager will be done on the London Metal Exchange. Serious and prolonged surpluses would bring about organized production cuts.

To sum up: Tin production in 1957 should be equal to 1956. Surplus is certain to be greater now that metal, formerly produced in Texas and stockpiled by the U. S., is falling on the world market. Release of 2,500 tons of tin by the British Board of Trade will also act as a depressing factor. A surplus of about 15,000 tons is expected, but will depend on world needs. Such a surplus could be absorbed by Tin Agreement requirements, making it unlikely that production cuts will be needed in 1957.

The indication is that the U. S. will not purchase or barter for tin in 1957. Authorization to purchase tin may be discontinued in June.

With peace prospects high and the Suez on its way to being cleared, outlook is for a steady tin market in 1957. The added surpluses will depress the market, but if not excessive, the average price of tin in 1957 should range between 90c to 95c. If consumption should drag, and there is no reason to believe it will, dropping the price below 90c, look for the Tin Agreement to take positive action. U. S. prices will jump up if the New York dock workers strike in February. Negotiations are in progress.

Happily, consumers should have little trouble in obtaining their requirement of tin in 1957, barring, of course, a serious strike or an incident to rival Suez•

Tin Highlights—1956

June—President okays extension of Texas City smelter; authorizes sale. Lowest *E&MJ* monthly average for 1956, 94.635c a lb.

July—Organization of International Tin Agreement completed. Nationalization of Suez Canal sets off scare buying. Workers walk off jobs in Malaya; general strike threatened. Steel strike affects tinplating industry.

Sept.—Egypt invaded; scare buying sends New York and London prices upward; Canal closed; Far East shipments re-routed.

Oct.—Recurring Malayan strike threats.

Nov.—U. S. dock strike pushes New York price to 113.750c. Highest *E&MJ* monthly average for 1956, 110.750c.

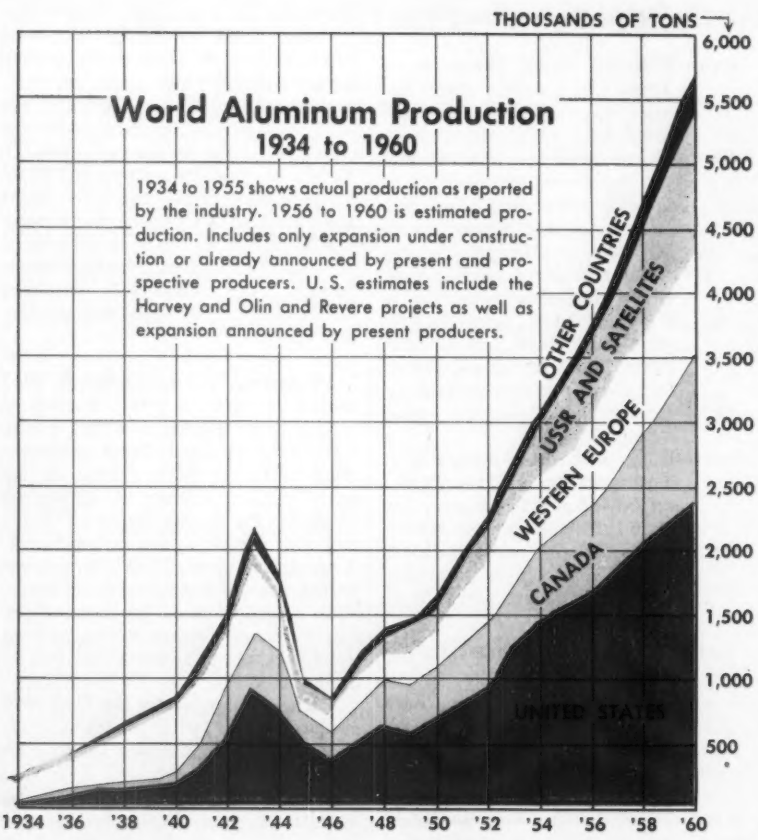
Dec.—Great Britain releases 2,500 tons of tin from its stockpile. Texas City smelter sold to Wah Chang Corp.

Aluminum

Irving Lipkowitz
Reynolds Metals Co.

A HEALTHY BALANCE between a growing supply and an expanding demand was the outstanding feature of the 1956 aluminum picture. For the fifth year in succession, domestic producers set a new primary output record and the industry as a whole established a new high for shipments of aluminum products.

Both of these records are particularly notable because they were achieved despite several adverse con-


THOUSANDS OF TONS
World Aluminum Production
1934 to 1960
1934 to 1955 shows actual production as reported by the industry. 1956 to 1960 is estimated production. Includes only expansion under construction or already announced by present and prospective producers. U. S. estimates include the Harvey and Olin and Revere projects as well as expansion announced by present producers.
OTHER COUNTRIES
USSR AND SATELLITES
WESTERN EUROPE
CANADA
UNITED STATES
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
1934 '36 '38 '40 '42 '44 '46 '48 '50 '52 '54 '56 '58 '60

ditions. Production would probably have been higher except for work stoppages at some plants during August when new labor contracts were being negotiated. Product shipments would also have been higher had there not been a sharp decline in aluminum's two largest markets: construction and transportation.

Net result of these market conditions was a year of adequate supply for consumers and unrestricted selling and market development for the aluminum industry. 1956 was the first full year since the end of World War II when efforts of neither buyers nor sellers of aluminum were constrained by insufficient supplies.

Production. Domestic primary aluminum production was 1,683,000 tons in 1956, about 7½% above 1955. Adequate electric power and a plentiful ore supply made for good operating conditions throughout the year.

New domestic facilities completed and put into production during 1956 brought total capacity at the year-end to 1,762,000 tons, as against 1,609,000 tons at the beginning of the year.

World production also rose to an estimated 3,691,000 tons, or almost 8½% higher than the 1955 total. The U.S. continues to be the world leader, with 46% of the total—the same share it had in 1955. Relative rank of other major producing areas, however, has changed as shown in the accompanying table.

Western Europe, slightly behind Canada in 1955, was well ahead in 1956 for the first time since 1941. If 1956 estimates on Russian sphere production prove reliable, that area also may have outproduced Canada. by a slight margin. Poor water conditions, rather than lack of capacity, were primarily responsible for Canada's comparatively low level of production in 1956.

World bauxite supply kept pace with the expanding industry. During the first nine months of 1956, total bauxite supplies (domestic and imports) amounted to 5.8-million tons, a 12% increase over the corresponding period for 1955.

Imports continue to be the principal source of bauxite, accounting for 77% of the 1956 supply (first nine months). Jamaica was the largest single source, supplying 38% of the total U.S. supply. Surinam is next with 35% and Arkansas third with 22%. The remaining 5% came from British Guiana, Alabama and Georgia.

During 1957 still another country, Haiti, will be supplying part of the bauxite requirements of the U. S. industry. After many years of development work, including construction of roads and harbor facilities, bauxite mining in Haiti was begun during 1956.

Clay. Another major step toward the commercial use of clay in the production of alumina and aluminum was taken during 1956 when one of the domestic producers announced that "after nearly two years of laboratory and test plant work it has solved the problem of producing alumina from clay located in the area of Moscow, Idaho."

As a result a pilot plant of 50-tpd capacity is being built "from which it is expected a full-scale commercial plant will be developed with adequate capacity to furnish the company's total requirements for alumina on an economically competitive basis." The pilot plant is scheduled for completion late in 1957 at a cost of slightly more than $1-million.

U. S. aluminum supply. Total aluminum supply in the U. S. increased to an estimated 2,348,000 tons in 1956. This 8% increase resulted principally from the rise in domestic primary production but also reflected larger imports and a larger supply of scrap.

Market conditions. From the beginning to the very end of 1956, aluminum was more plentiful in the U. S. market than in any other year. The most important reason was the high level of production. Another factor was that at the industry's request, mobilization authorities had decided to cancel 1956 stockpile calls for aluminum. Military requirements were relatively small during 1956, making the supply almost entirely available to industry.

The supply picture was also affected by the decline in automobile production and in housing construction. All in all, there was enough aluminum for sale in 1956 to satisfy the requirements of all who were ready to use it.

The challenge of this larger supply was met by all branches of the aluminum industry, from the smallest fabricator to the largest producer. There was an unmistakable emphasis on selling, on the development of new uses and larger markets. As a result, it was particularly evident that alu-

minum was penetrating a wide range of industrial and consumer markets. Basic competition between major metals and between aluminum and other materials came into sharper focus and took on more significant proportions.

The importance attached to this competition between basic industries is revealed in a speech made by the executive vice president of U. S. Steel during the recent Congress of American Industry:

> "Many years ago, we came to the realization that we could sell our customers only the quantity of steel which they required to produce the products which they, in turn, could sell to their customers. At that time, we recognized only the competition of other steel producers. Our new concept, however, recognizes that our primary challenge arises initially from other metals such as aluminum, magnesium, titanium and copper, and—in addition—from wood, glass, masonry and plastics, to mention but a few. Pursuing this concept, we realize that when a housewife in a department store chooses a product made of some material other than steel, our customers lose the order then and there; and we in turn lose our opportunity to serve them. In recognition of this fact, while we as a corporation produce relatively few products that are sold directly to the ultimate consumer, indirectly we have a very substantial stake in the consumer market. Hence, we are in double harness with our customers and have an obligation to pull our full share of the load."

This view of today's competition between the metals is also reflected to an increasing degree in the institutional advertising of major producers of steel, copper, nickel and ferroalloys.

There was a notable increase during 1956 in the aluminum industry's efforts to reach the ultimate consumer. The principal primary aluminum producers make extensive use of TV network advertising (much more than does any other metal industry) to reach the general public. This is in addition to regular trade and business publication advertising to reach industrial customers.

During 1956 there was also greatly increased sales emphasis by the industry on such consumer products as household foil which also contributes towards making and keeping the public aluminum-conscious.

U. S. Aluminum Supply

(Thousands of tons)

	1956 estimated	1955
U. S. primary production	1,683	1,566
Primary imports	244	197
Scrap (recoverable content)	421	407
Total supply	2,348	2,170

World Production of Primary Aluminum

	1960 estimated	1956 estimated	1955
United States	2,424	1,683	1,566
Western Europe	880	686	600
Russia and satellites	1,052	616	546
Canada	1,112	600	608
Other	266	106	85
World total	5,734	3,691	3,405

Consumption. The combined effect of the availability of a larger supply and the industry's more vigorous sales efforts was a record consumption. Shipments of mill products ran about 8% higher than in 1955. During seven of the first ten months of 1956, these shipments were higher than the year before. Two of the three low months, August and September, reflect in part the August plant shutdowns.

Actual consumption during 1956 was probably higher than shipments because of inventory changes. Recurrent shortages of earlier years had encouraged many fabricators to carry relatively large inventories of aluminum stocks. Easing up of the supply situation resulted in a reduction of working inventories by many fabricators.

In addition, the August strike made it necessary for some manufacturers to eat into their inventories to maintain their own level of operations.

Outlook. The aluminum industry continues to be confident about the future growth of its markets. Consequently, there has been no relaxation of efforts to expand primary producing capacity. New U. S. facilities under construction will increase primary capacity by almost 40% during the next two years.

This optimism as to future markets is not confined to the domestic producers. As the world production chart shows, all of the other major producing areas in the world also are expanding their primary capacity during the years immediately ahead.

Underlying this world-wide confidence is the growing acceptance of aluminum for a wide variety of uses and the relative ease, compared to some competing metals, with which basic supplies can be expanded. An important factor in this connection is the successful development of a variety of finishes and colors which are opening up additional markets and applications. *Every* automobile manufacturer, for example, is using some aluminum trim on 1957 cars. These colors and finishes have also led to a much more widespread use of aluminum panels in commercial, institutional and residential construction.

Aside from development of new markets, the aluminum industry also expects further progress in its established markets. Use of aluminum per car should soon increase from a 35-lb average in 1956 models to over 100 lb. Similarly in construction, the trend towards aluminum windows, panels, insulation, architectural trim and hardware means more aluminum per building.

Continued growth of the electrical market is also expected because of aluminum's demonstrated ability to expand its supply more readily and economically than the copper industry can. This factor is important because the power industry's plans for expansion during the next few years will require considerably larger tonnages of electrical conductor metals for transmission, power generating and power consuming equipment. In view of its advantageous supply and price position compared to copper, the prospect is that aluminum will be used to an increasing degree to meet enlarged requirements.

Appliance, furniture and packaging markets also show signs of becoming much larger consumers of aluminum.

In appraising the prospects of aluminum for the next few years, the probable demand cannot be estimated as readily as can the probable supply. Known capacity data on facilities already in place and on facilities under construction provide an adequate basis for estimates of probable supply. Presently known uses of aluminum, however, are not sufficient in themselves to determine probable demand for the near future because new and developing uses can make an important difference in the size of tomorrow's markets. The all-aluminum automobile radiator, for example, has been under development for some years now, and has undergone extensive testing. The Ford Motor Co. executive vice president for

basic manufacturing stated recently that, "in the very near future, we hope to have all-aluminum radiators."

This new automotive application, and similar pending uses, would materially increase aluminum markets during the next few years.

Because of these very real possibilities, the statistics on future demand are likely to be on the low side (as they have frequently been in recent years) as long as the industry's growth characteristics continue to be strong.

In summary, the pattern of the aluminum industry, both here and abroad, promises to be one of continued growth: the development of larger markets and the creation of additional capacity to supply those markets will carry it forward•

Copper

(*Continued from page 82*)

times the spread in copper prices was 8 to 9c a lb.

Most sellers, in the first three or four months of 1956, had no problem getting enough to cover operating and expansion costs and making good return on investment. For producers these were "lush" days. For custom smelters and even more so for dealers whose costs largely depend on materials they buy, profits were not as lush, but they did well.

Price dispersion in 1956 reflected different price policies by copper sellers. Producers, with fixed investments and relatively stable costs, were able to raise prices less than was necessary for custom smelters and dealers. Dealers had to raise most because their costs—copper from copper-bearing materials, small producers and from irregular sellers such as fabricators who had a few tons more than they needed—are most volatile. Producers were more concerned with substitutes because of their fixed investments; dealers could easily switch their funds, even into the substituting lines. The dealer function is in part to provide metal to users with an irregular demand; these often expect to pay a higher price. Prices in 1957 will be more stable and less dispersed.

London Metal Exchange prompt bid price reached about 54½c late in March 1956; in a few months it had dropped about 22c to a low of 32.9c. Custom smelters reached about the same high price and came down to under 35c for U. S. customers by January 1957. Dealers went to about 55c in the U. S. and dropped to a low of about 34c.

U. S. producers raised the price from 43c delivered to 46c late in February and the Rhodesian Selection Trust companies rose to £385—about 48¼c at the existing exchange rate.

By June 1956, U. S. custom smelters were at 40c but producers were still at 46c. Some custom smelter intake of ores and concentrates was at the *E&MJ* average price of about 45c (less processing and other deduction) but they were selling their copper at 40c. Such a spread was the reverse of an earlier period when their price was much higher than the producer and average prices. During this earlier period, smelters probably had to return some copper to the ore producers. But smelters, like other sellers, realized heavy profits in this period.

July 10th to 12th, U. S. producers, led by Phelps Dodge, dropped their price from 46c to 40c delivered. London had reached about 35¼c. The slowness with which U. S. producers followed other prices down was appreciated less by fabricators than the slowness with which they followed other prices up late in 1955 and early in 1956. Some analysts say the slowness to reduce prices has not diminished conviction among fabricators that they should maintain a "position" with producers.

Copper statistics, including sales by producers, smelters, etc., even if available, are inconclusive. Fabricators largely continued to buy from producers, but in this declining market, they might have bought even more if producers had reduced prices more rapidly.

Ordinarily, producers have a larger proportion, as well as absolute amount, of copper committed ahead; custom smelters have a smaller proportion, and dealers least. In a declining market, producers are likely to maintain sales and shipments better than custom smelters and smelters better than dealers. Dealers and custom smelters attempt to offset this by lower prices (often dealer prices are lower than smelter prices). That smelters and dealers have continued to sell as well as they have, may indicate some success of this policy, and perhaps some disappointment by buyers in producer prices.

In late October, U. S. producers dropped to 36c. When prices were falling in 1956, custom smelters often sold well under producers. When the latter dropped the price, smelters on several occasions raised their prices to close the producer price. This reflected, perhaps not primarily, the market situation and the need of smelters to sell at close to the average price because much of their intake was based on that price. As prices get lower it is much easier to narrow the spread. Before the middle of December, smelter copper was being sold in the U. S. at about 35c and dealer copper in early January at about 34½c.

Copper Mine Capacity

(Thousands of short tons)

	U. S. capacity	Other capacity	World capacity
1955.....	1,014	1,968	2,982
1956.....	1,130	2,183	3,313
1957.....	1,190	2,315	3,505
1958.....	1,226	2,391	3,617
1959.....	1,237	2,444	3,681
1960.....	1,244	2,578	3,822
1961.....	1,278	2,652	3,930
1962.....	1,278	2,666	3,944

U. K. sells copper. The British Board of Trade on July 2, 1956, announced it would sell 36,000 tons of copper from its stocks. It indicated it would sell at prices based on market prices at time of sale. But the announcement pushed prices down in Europe. Later prices recovered somewhat with heavy scare buying in Europe caused by the Suez trouble.

Although the U. K. Government has said it does not wish to reduce prices, Macmillan, in his economic report of March 1956, said nonferrous metal prices were too high. Copper then was about 54c in the U. K. When the decision to sell was announced by the U. K. it was some 20c lower.

Labor difficulties were somewhat reduced during 1956 and in June, most U. S. copper mines and smelters entered into three-year contracts with unions which could mean extended peaceful operations.

Government in early 1956 diverted much copper destined for the U. S. stockpile to industry. In December 1955, ODM deferred about 14,000 tons. In March it deferred until Dec. 31, 1956, about 36,000 tons. Troubles in connection with future delivery caused some firms to deliver anyway. Near the end of 1956 the U. S. Department of Commerce liberalized copper export limitations•

Minor Metals

Abbott Renick
Commodity Specialist
U. S. Bureau of Mines

"Antimony consumers in the U. S. used foreign sources exclusively. Stibnite smelter will supply the stockpile."

James W. Pennington
Assistant Chief, Base Metals Branch, U. S. Bureau of Mines

"Mercury's 20% increase in domestic production was aided by Idaho-Almaden and Red Devil mine."

John E. Crawford
Commodity Specialist
U. S. Bureau of Mines

"Thorium's future as a nuclear fuel remained uncertain. Magnesium - thorium alloys show a bright future."

Donald E. Eilertsen
Commodity Specialist
U. S. Bureau of Mines

"Beryllium's bright outlook is based on growing industry consumption and new atomic energy uses."

Albert E. Schreck
Commodity Specialist
U. S. Bureau of Mines

"Lithium consumption was at a record level as the postwar comeback continued. Supplies were good."

Daniel S. Dinsmoor
Vice President, Planning and Development, American Potash & Chemical Corp.

"Boron's potential via accelerated research programs is still undetermined."

Kenneth B. Higbie
Commodity Specialist
U. S. Bureau of Mines

"Zirconium production capacity of 5-million lb per year is planned for reactor grade in 1957."

Arnold M. Lansche
Commodity Specialist
U. S. Bureau of Mines

"Cadmium supply exceeded demand by 11%. Consumption held close to the record high of 1955."

Elmo G. Knutson
Commodity Specialist
U. S. Bureau of Mines

"Semi - conductors relied heavily on both selenium and germanium: silicon gained wider use."

Julius P. Ryan
Commodity Specialist
U. S. Bureau of Mines

"Platinum - group metals continued to enjoy a strong demand. Stability of prices was significant."

Charles T. Baroch
Assistant Chief, Rare and Precious Metals Branch, U. S. Bureau of Mines

"Rare earths supplies continued to accumulate as research intensified."

Antimony

Abbott Renick
U. S. Bureau of Mines

ESTIMATED WORLD PRODUCTION from mines in 1956 will be about 10% below the 50,000 tons produced in 1955. The United States continued to depend upon foreign sources for antimony concentrate and metal. Domestic mine production was confined to an impure byproduct metal recovered by Sunshine Mining Co., Idaho, during the processing of silver-lead concentrates.

In the middle of the year the Bradley Mining Co. reactivated the company smelter at Stibnite, Idaho, to process and refine the Sunshine Mining Co.'s 2,000-ton stockpile of cathode antimony metal to meet Government strategic stockpile specification.

Domestic smelter production of primary antimony in 1956 is estimated at about 9,000 tons, compared with 8,200 tons in 1955. In addition about 1,600 tons of antimony contained in domestic and foreign silver and lead ores was recovered, as compared to 2,000 tons in 1955. Recovery of secondary antimony will approximate 22,000 tons, a decrease of about 7% from the 23,700 tons for 1955.

Antimony Statistics

(Short tons)

	1956 estimated	1955
U.S. mine production	550	630
General imports	12,000	13,000
Consumption of primary antimony	12,000	12,500
Avg. price, primary antimony metal, RMM brand, in bulk, 99½%, f.o.b. Laredo, cents per lb	33.00	33.18

Based on information for the first nine months, it was estimated that the total consumption of antimony during 1956 would be about 35,600 tons, or 6% below the 38,000 tons consumed in 1955.

Of the estimated 12,000 short tons imported in 1956, 6,500 tons was in ore and concentrate, 4,300 tons as metal and 1,200 tons in oxide. Comparable receipts in 1955 were 7,500, 3,700 and 1,800 tons, respectively. Based on data for the first nine months of 1956, Mexico, Bolivia and Union of South Africa supplied 85% of the ore and concentrate; Yugoslavia, United Kingdom and Mexico 74% of the metal; and United Kingdom 74% of the oxide.

Price of domestic antimony metal, RMM brand, f.o.b. Laredo, in carlots, remained unchanged since August 1955, at 33c per lb. Average New York price for metal, RMM brand, in cases was 34.97c per lb compared with the 1955 average of 32.18c. New York price for foreign brands of metal, prevailing on Nov. 30 (duty paid in lots of 5 tons or more) was as follows:

Foreign brands, cents per lb	
99.6%	28.0 @ 29.0
99.5%	27.5 @ 28.0
99.0%	27.0 @ 27.5

Demand for antimony, in the form of Bolivian chemical grade ore, continued firm in 1956. According to *E&MJ Metal and Mineral Markets*, price for minimum 65% ore remained stable throughout the year at $4.05 to $4.20 per short ton unit. According to the same source the New York price of antimony oxide in carload lots, in bags, went from 29c in January to 27@29c by year end and price for less than carload lots, in bags went from 30.5c to 28.5 @ 30.5c at year end•

Mercury

James W. Pennington
U. S. Bureau of Mines

THE FIRST FULL YEAR'S operation of the Idaho-Almaden mine near Weiser, Idaho, and the rehabilitation of the Red Devil mine in Alaska were largely responsible for the increase in U.S. production as well as Idaho and Alaska gains in share of the nation's output. About 90% of the metal was supplied by 15 mines with the remainder derived from 90 smaller operations.

Output of domestic mercury mines increased for the sixth consecutive year to an estimated 23,000 flasks—about a 20% gain over 1955 and the largest since 1947, which it approximated.

As usual, California led all states in mercury production; however, of the U.S. total, California mines supplied only 35% compared with 52% in the preceding year. Nevada was in second place with 25%—down from 30% in 1955; Alaska and Idaho together accounted for 30% compared with 6% the year before, and Oregon and Texas furnished the rest.

Mercury Statistics

(76-lb flasks)

	1956 estimated	1955
Production (mine)	23,000	18,955
Imports (general)	52,000	20,648
Consumption	49,000	57,185
Avg. price, N. Y.	$260.00	$290.35

Secondary production of mercury returned to a normal level after an unusual high in 1955. About 4,200 flasks were reclaimed from January through September compared with 8,600 flasks in the similar period of the preceding year. If this rate continued, the annual secondary production would be 5,600 flasks or 20% of the combined primary and secondary production.

Imports rose in the first quarter of the year and continued at an equally high level for the succeeding two quarters. Nearly 40,000 flasks were imported during the first nine months compared with about 12,000 flasks in the like period of 1955. Total 1956 general imports may exceed 50,000 flasks. Spain and Italy regained positions as leading suppliers by furnishing 36% and 30%, respectively, of U.S. imports. Mexico's share dropped to 25% from 50% in 1955 and Yugoslavia's fell to 6% from 19%. Data on exports and re-exports, usually small, were not available.

Industrial consumption in the first three quarters totaled 36,400 flasks,

a 20% decrease from the similar period of 1955. Drop in consumption resulted largely from less metal being used in the installation of chlorine and caustic soda plants using mercury cells and in electrical apparatus. During the year one chlorine and caustic soda plant using mercury cells was placed in operation, capacity was expanded at another, and a third facility was scheduled to start the last quarter of the year. Consequently, the total mercury consumption for the year was probably 49,000 flasks, a drop of about 8,000 flasks from 1955.

Increased domestic production, high imports, and lower consumption indicated an excess of mercury; confirmed by the growth in industrial stocks from 10,000 flasks at the beginning of January to 19,500 flasks at the end of September.

Prices declined slowly from $275 to $279 a flask in January to a range of $255 to $257 a flask in July. Following this, except for a small fluctuation in late October, prices continued the latter half of the year at $255 to $257 a flask. Average price for the year was expected to be about $30 a flask below 1955's high of $290.35 a flask.

Two Government-sponsored programs—DMEA's exploration assistance and GSA's guaranteed sale price—continued throughout the year. The former provides loans up to 75% of the exploration costs for eligible mercury deposits; the latter provides for the purchase, at $225 a flask, of a maximum of 125,000 flasks of domestic mercury and 75,000 flasks of Mexican metal, and is scheduled to end Dec. 31, 1957. The purchase program also provides for foreign contracts, particularly with mercury producers in Canadian mining areas.

Outlook for the mercury industry appears favorable for expansion in production and consumption. Activity continues, both in and outside of U.S. in exploration, development, expansion of existing and construction of new facilities. Plans have been announced for the installation and expansion of chlorine and caustic soda plants using mercury cells. New uses of mercury in pigments and as a catalyst in the manufacture of methyl styrene, both potential volume uses, were reported•

Thorium

John E. Crawford
U. S. Bureau of Mines

INCREASING QUANTITIES of thorium were required in 1956 by high-temperature, thorium-bearing magnesium alloys. Investigations of thorium's potential in nuclear energy were intensified and AEC announced that reactor-grade metal was purchasable from its stocks.

Domestic and foreign monazite provided the bulk of U.S. supply, along with ilmenite and rutile. Dredges worked in Florida and South Carolina. Operations in Idaho halted except for a euxenite placer in Bear Valley. Some concentrate was obtained from a complex uranium-thorium-columbium-tantalum mineral by Mallinckrodt Chemical Works. Monazite was produced in Australia, Brazil, Ceylon and Union of South Africa.

In June, Davison Chemical Co. and its affiliate, Rare Earths, Inc., opened a $2-million processing plant at Curtis Bay, Md., to join Lindsay Chemical, Maywood Chemical, and Metal Hydrides as a producer. New 15- to 25-tpd unit is currently treating raw material from the Government stockpile and, in a separation and refining operation, provides AEC with specified thorium salts, returning an insoluble double rare-earth salt.

Westinghouse Electric Corp.'s lamp division prepared a small amount of thorium metal from refined salts for use in electrical equipment, and a number of firms were reportedly engaged in research concerning methods of producing high-purity thorium metal.

Thorium Compound Prices

(In 100-lb lots)

Compound	Per cent ThO_2	Price
Carbonate	80 to 85	$7.25 to $8.80*
Chloride	50	7.00
Fluoride	80	6.50
Nitrate (mantle grade)	46	3.00
Oxide	97 to 99	8.25 to 9.35

*Variable on rare-earth content.

Now classified a source material, thorium is authorized by AEC for procurement, in any form, by industry for essential use. Licenses are no longer required for purchase or sales to AEC, therefore 1956 statistics are not available through that agency.

Significant growth continued in the use of thorium in magnesium alloys, notably the Dow developed HK31, for aircraft and guided missiles, because of its light weight, strength at elevated temperatures and good forming properties. The alloy, weighing only ¼ as much as steel, has expressed good strength and elastic modulus characteristics to temperatures of around 600 deg F, good creep resistance, can be heat-treated and welded, and is available from fabricators in cast and wrought forms. AEC issued source material licenses to Glenn L. Martin Co. and Aerojet General Corp., for 2,010 lb and 600 lb of thorium respectively for the special magnesium alloy to be used in the earth satellite, Project Vanguard.

Consolidated Edison Co. announced in 1956 that it had purchased from the AEC 27,500 lb of thorium metal for $537,000. The thorium will be used by Con Ed's contractor Babcock & Wilcox Co., in conducting critical experiments with a full-sized reactor core at the Lynchburg, Va., nuclear equipment plant, prior to installation of their reactor at the Indian Point, N.Y. site.

Gas mantle manufacture continued to account for a great portion of thorium procurement authorizations in 1956, and other classifications which were responsible for consumption included refractories and polishing compounds, chemical and medical fields and electrical equipment.

Outlook is good for thorium in high-temperature magnesium alloys. Most of the applications for this alloy to date have been in defense products, but with increased publicity about its versatility there is an opportunity for more widespread use. Short of an emergency situation, there is little reason to expect that domestic consumption of thorium nitrate for gas mantles will increase in 1957, but export of the nitrate for mantle production in

foreign countries will probably continue to increase.

Nuclear power potentials are still deemed exciting, but there exists little room for optimism. Thorium's role in nuclear fission processes requires more information, some of which may be gained through AEC studies and operation of Con Ed's Indian Point plant (under construction) and the Detroit (Mich.) Edison project at Monroe (in the planning stage) •

Beryllium

Donald E. Eilertsen
U. S. Bureau of Mines

AFTER INVITING INDUSTRY to submit proposals for supplying reactor-grade beryllium, the Atomic Energy Commission in September 1955 announced that it had contracted to purchase 1-million lb of metal from two firms, Beryllium Corp. of Reading, Pa. and Brush Beryllium Co., Cleveland, Ohio. Each received an order for a half-million pounds at an average price of $47 per lb to be delivered over a five-year period. Both producers are expanding their operations; one is scheduled to start delivery in mid-1957, the other early in 1958.

Life and growth of the beryllium industry are solely dependent upon the supply of beryl, the only commercial-source mineral of beryllium. Beryl is usually mined as a by-product or co-product in the mining of feldspar, mica or spodumene, and it is seldom profitable to mine it alone. During the past several years only 12 to 33% of U. S. beryl consumption has been produced domestically, and this, like most world production, is obtained by hand-sorting methods to upgrade it for commercial use.

Beryl Statistics

(Short tons)

	1956 estimated	1955
World production	14,000	8,700
U. S. mine shipments	550	500
U. S. imports	11,500	6,037
Total new supply	12,050	6,537
Consumption	4,500	3,995
Avg. U. S. price per unit BeO	$49.50	$49.50
Avg. foreign price per unit BeO	$38.50	$38.50

Research is being conducted by USBM at its experiment stations at Rapid City, S. D., and University, Ala., searching for improved processes to recover beryl from deposits and for new processes of extracting beryllium from concentrate. Results of this work appear to be promising.

A new find of beryl near central Colorado was reported, and plans for developing two other deposits, one in Nevada and one in Manitoba, Canada, were disclosed.

Preliminary estimates indicate that world production and imports of beryl will reach new highs in 1956, and the downward trend of domestic production during the past two years will come to a halt. Consumption of the mineral, up 500 tons this year, is expected to be high.

Outlook. General Services Administration's purchase program for domestically produced beryl has been extended to June 30, 1962, or when deliveries total 4,500 short tons, whichever occurs first. By Sept. 30, only 1,007 tons were purchased by the Government. Along with this and subject to legislation, the Defense Minerals Exploration Administration will continue to encourage exploration for domestic resources of beryl, by giving aid to applicants that meet certain requirements. World and domestic production of beryl, and U. S. imports and consumption of the mineral should continue high.

The civilian demand for beryllium products coupled with AEC purchases of reactor-grade beryllium should keep the industries busy •

Lithium

Albert E. Schreck
U. S. Bureau of Mines

COMPETITION AMONG PRODUCERS was strong in 1956 as production capacity surpassed commercial demand. Domestic capacity increased with the coming into production of American Lithium Chemicals Ltd. and a 165-tpd influx of Canadian spodumene averaging 4.5% Li_2O to Lithium Corporation of America's Bessemer City, N. C., plant from Quebec Lithium Corp., which started during 1956.

Southern Rhodesian lepidolite is converted to the hydroxide by alkaline process at American Lithium Chemicals Ltd., a subsidiary of American Potash & Chemical Co. The latter continued production of lithium carbonate from the dilithium sodium phosphate recovered as a by-product from its Searles Lake operation. Lithium Corp.'s South Dakota mines and mills were closed down in mid-year and the Minneapolis plant was converted solely to manufacture of lithium metal, hydride and other special lithium compounds.

U. S. Lithium Reserves

(Millions of 20-lb units Li_2O content)

	Indicated	Inferred
North Carolina	4	124
South Dakota	1.2	400
California	9	*

*Not available.

Foote Mineral Co. installed additional processing facilities at Kings Mountain and also planned to enlarge plant laboratories and other facilities. A new metal-producing cell was installed at the Exton, Pa., plant. Maywood Chemical continued to operate on hand-cobbed South Dakota ores and some domestic and imported ores. A Sao Paulo, Brazil, firm produced some carbonate for domestic lubricant manufacture, with the remainder to be exported to the U. S.

Exploration increased in Val D'or,

Que., area, at Cat Lake and Winnepeg River in Manitoba and at Yellowknife, Northwest Territories, where many new firms were organized to drill and block out orebodies. In the Kings Mountain area of North Carolina, numerous deposits were explored and new companies formed, with several announcing development plans. However, the competitive situation sharply discouraged expansion.

Ore reserves information increased substantially in the U. S. (see table) and Canada's potential is estimated to exceed 25-million tons.

New technology included roasting of lepidolite with limestone in a rotary kiln and subsequent leaching to recover lithium hydroxide. Process has several advantages in that lepidolite can be roasted at a lower kiln temperature than spodumene and is easier to work with. A new chloride volatilization method was described, in which spodumene is roasted with calcium chloride to produce volatilized lithium chloride in solution with accompanying production of cement clinker. Latter process is not yet in commercial use.

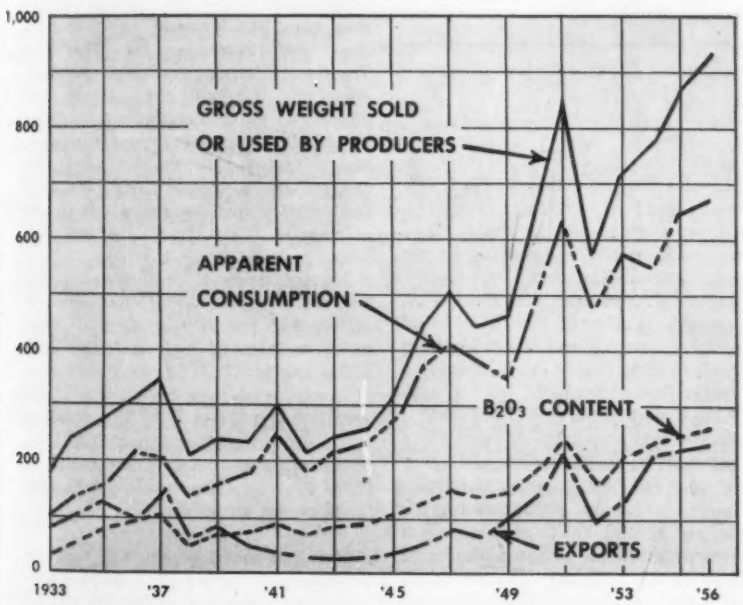
Consumption of lithium compounds topped previous records, with a probable two-thirds going to the grease and ceramic industries. Imports were also substantially greater, principally due to Lithium Corp.'s Canadian contract and ALC's use of Rhodesian lepidolite at the San Antonio plant, which began output in early 1956.

Industry research concentrated on improving operations efficiency and finding new markets for compounds. The American Lithium Institute was organized late in the year to coordinate research and disseminate information.

Outlook for the industry is one of increased consumption in established uses, lower prices and development of new uses and markets. One potentially large outlet is in manufacture of diborane fuels if these are used in jet and rocket fuels. Other possibilities occur in the fields of alloys, chemistry, petroleum, welding and air conditioning•

U. S. Boron Minerals and Compounds, 1933-1956

(Thousands of short tons)



Note: 1954- preliminary; 1955-56, estimated

Boron

Daniel S. Dinsmoor
American Potash & Chemical Corp.

PRODUCTION OF BORATES for 1956 is estimated to pass the 900,000-short-ton mark with the U. S. supplying over 95% of the world's supply. Total U. S. production was supplied by three companies from two separate deposits located in the Mojave Desert region of southern California.

Market demand was consistently strong throughout the year with the price remaining firm. Some small price increases have been announced for the coming year. Barring unforeseen developments, the industry's growth curve should be normal in 1957.

World borate reserves appear to be adequate for the foreseeable future; and with completion of one producer's conversion from underground mining to open-pit operation, the known reserves of recoverable boron will be increased by at least 60%.

Known borate deposits in various other parts of the Free World were for the most part not operated because of their inability to compete with the California operations. Those that are operating do so either for a special local market or because of special demand for calcium borate ores. In both cases production is insignificant compared to California production.

American Potash & Chemical Corp. continued to produce borax from the brines of Searles Lake at Trona, Calif. In 1955 and 1956 process changes were adopted which resulted in about a 25% increase in borate production.

During the year, Pacific Coast Borax Co., a division of Borax Consolidated, Ltd., which supplies about 70% of the total domestic production from the Kramer deposit at Boron, Calif., became United States Borax & Chemical Corp. following a merger with United States Potash Co. The Kramer borate deposit has been mined since its discovery in the middle 1920's by various underground methods. Late in 1955 the company announced an $18-million expansion project involving open-pit mining and a new refinery. Stripping operations began early in 1956; and toward the end of the

year it was estimated that the pit should be ready for production during the second quarter of 1957. Construction of the refinery is proceeding simultaneously with overburden stripping and pit preparation. Company also operates a colemanite mine at Shoshone, Calif., which produces a few hundred tons a year for special uses.

West End Chemical Co., which also produces borax from Searles Lake brines, was acquired by Stauffer Chemical Co. during 1956. Stauffer announced plans in the year for increasing capacity for boric acid and boron trichloride.

California Borate Co., the latest to enter the borate industry, began rehabilitation of the old Western Borax mine workings late in 1955. Most of 1956 was devoted to surface installations and to underground development work on the adjacent Little Placer property. The California Borate Co.'s property lies to the south of the U. S. Borax & Chemical Corp.'s holdings and is thought to be a part of the same orebody.

Four companies produced relatively small tonnage of boracite in Turkey for European consumption. These were the only borate mines outside of the U. S. known to be operating.

Boron Statistics

(Short tons)

	1956 estimated	1955 preliminary
Sold or used by producers		
Gross weight	920,000	875,000
B_2O_3 content	263,000	250,000
Exports	240,000	224,000
Apparent consumption	680,000	651,000

Principal users of boron compounds are still the glass and ceramic industries. The latter can be expected to require larger quantities in the future as steel and aluminum enameled panels are more widely used in construction. Borax has long been used as an ingredient in soaps and cleaning compounds as well as in pharmaceuticals, starches, chemicals and hundreds of other minor applications. Still undetermined, however, is the potential that may result from the accelerated research programs on elemental boron, metal borides and organo-boron compounds. In 1956 American Potash & Chemical doubled the working space at its research laboratory at Whittier, Calif. U. S. Borax announced plans to build a million dollar research lab•

Zirconium

Kenneth B. Higbie
U. S. Bureau of Mines

INTEREST SKYROCKETED in hafnium-free zirconium during 1956. Rapid expansion of the atomic power program has spurred the need for millions of pounds of reactor-grade zirconium to be made available for constructing atomic reactors, the heart of power units harnessing atomic energy.

Demand for zirconium metal for structural and fuel element applications in reactors was accelerated by the overwhelming success of the atomic submarine Nautilus. Plans have been reported for an atomic naval fleet of at least 2 surface and 15 submarine vessels, and one merchant ship. Peaceful applications of atomic power for generating electrical energy and applications to other scientific research fields augment the defense program requirements for zirconium.

Metal production increased to about 450,000 lb in 1956, through activity of the Carborundum Metals Co., and Wah Chang Corp. Industrial capacity for producing reactor-grade zirconium metal increased from zero in 1949 to 625,000 lb at the end of 1956, and will be over 5-million lb by the end of 1957. During the year, however, AEC contracted with three domestic companies for the purchase of 11-million lb of reactor-grade zirconium metal to be delivered over a five-year period.

A dispersed zirconium industry has resulted from the AEC contract. National Distillers Products Corp. is building a plant at Ashtabula, Ohio, which will produce 1-million lb per year; National Research Corp. is constructing a plant near Pensacola, Fla., to supply AEC with 700,000 lb of metal per year; and Carborundum Metals Co., Akron, N. Y. is erecting a plant at Parkersburg, W. Va., to supply the Commission with 500,000 lb a year. Actual capacity of the three plants will be in excess of AEC contracts. AEC also contracted with Japanese zirconium producers for the purchase of 400,000 lb of metal on a barter program for excess agricultural products. In addition, Carborundum Metal Co. was authorized to increase its production at Akron from 200,000 to 325,000 lb per year. Total cost of the contracts was expected to be approximately $14-million per year.

To increase the immediate supply of metal, in May, AEC authorized Wah Chang Corp. to operate the reactivated Bureau of Mines zirconium plant in Albany, Ore. and produce 300,000 lb zirconium for each of the next two years.

Other industrial changes in the present zirconium field include building of a new metal plant by Wah Chang in Albany and Kennecott Copper Corp.'s pilot plant at Cleveland, Ohio, to produce zirconium by the Horizons Titanium Corp. electrolytic process. Allegheny Ludlum Steel Corp. expanded its zirconium melting facilities to 125,000 lb per month and is capable of melting ingots up to 2,200 lb. Oregon Metallurgical Corp. installed facilities for melting zirconium ingots as large as 1 ton.

Market price of reactor-grade zirconium dropped slightly to approximately $12 per lb. Commercial-grade metal containing high hafnium sold for as low as $7.50 per lb. Production of commercial-grade metal was probably less than 50,000 lb. The pending expansion program is expected to lower the price of reactor-grade metal to $6 to $7 when large scale production facilities are completed.

Hafnium metal production reached a record high during 1956. Supply was controlled completely by the AEC. Obtained only as a co-product in the manufacture of reactor-grade zirconium metal, it was employed entirely in the atomic reactor program for use as structural material requiring corrosion resistance and a high neutron absorption characteristic. Hafnium is found in zircon concentrate to the extent of 1 to 3% of the metal content.

Keeping pace with the expanding metals program, several mining companies have expanded their facilities for recovering zircon concentrate to an extent that domestic production will rival Australian imports for U. S. mar-

kets. Florida holds vast reserves of zircon within recent and ancient deposits of beach sands. Recovery is by dredges which also mine rutile.

Outlook for zirconium and its compounds involves use of chemicals for refractory, ceramic, foundry sands and facings, and glass—all steadily increasing. Reduced costs from quantity production combined with its unique qualities will encourage new uses and consumption•

Cadmium

Arnold M. Lansche
U. S. Bureau of Mines

ELECTROPLATING, pigment manufacture, and production of silver-brazing and other low-melting-point alloys continued to be the chief consuming uses of cadmium in 1956. The tight supply experienced with cadmium sulphoselenide pigment, caused by an acute shortage of selenium, was somewhat relieved by use of cadmium mercury lithopone, a cheaper and more plentiful substitute.

ODM recommended that the Department of Agriculture procure cadmium for stockpiling by barter of agricultural commodities. Contracts let for procurement of strategic metals called for the addition of 470,588 lb of cadmium to the national stockpile.

Cadmium metal production was based on foreign and domestic lead and zinc concentrates and imported cadmium-bearing flue dust. Mexico was the chief foreign source. Some 57% of imported metal through the first nine months of 1956 came from Canada, Belgian Congo and Belgium-Luxemburg, the United Kingdom, Italy, Japan, Peru and West Germany.

Cadmium Statistics

(Thousands of tons)

	1956	Per cent from 1955
Supply	11,800	+11
Demand	10,600	−1
Shipments	10,500	−6
Producers' stocks	2,900	−5
Compound producers' stocks	140	+9
Distributors' stocks	230	none
Production	10,400	+7
Imports (9 months)		
Metal	1,050	−31
Flue dust, etc.	1,062	−37
Exports (9 months)		
Metal and flue dust, etc.	1,020	+9

Exports were received by the U.K. (53%), West Germany (29%), Netherlands, Mexico, Chile, Belgium-Luxemburg, France, Switzerland, Italy, Yugoslavia, India and the Philippines.

Quoted price of cadmium sticks and bars, delivered in 1- to 5-ton lots remained unchanged at $1.70 per lb through the year, with no premium on special platers' shapes. Larger quantities reportedly sold for less. In Canada, a somewhat higher price was asked, delivered at eastern Canada ports: lots of 5,000 lb or more, $1.75 per lb; 2,000- to 5,000-lb lots, $1.85 per lb; and less than 1 ton, $1.95.

As a research tool, cadmium aided in the detection of the very elusive neutrino, the smallest known particle of matter.

The very high thermal neutron absorption cross-section of cadmium, (2,400 barns per atom for the naturally occurring element) appears to make it an excellent substance for control and shielding of nuclear reactors: though offset by the disadvantages of production of gamma rays upon irradiation with neutrons, a relatively low melting point, relatively high vapor pressure and poor corrosion resistance.

Outlook for this year indicates a continued high-level output•

Columbium-Tantalum

Kenneth B. Higbie
U. S. Bureau of Mines

WORLD PRODUCTION of columbium-tantalum minerals dropped considerably during 1956. U. S. imports for the first nine months were 4,253,261 lb of columbite and 744,500 lb of tantalite, indicating a probable drop in total imports for the year of 40% for columbite, and a drop of 50% for tantalite as compared to 1955 figures.

Great expansion was noted during 1956 by the pure metal industry. In January, Fansteel Metallurgical Corp. announced a $1-million expansion in its North Chicago facilities. In July they announced plans for a second plant at Muskogee, Okla., at a cost of $6.5-million. The second plant, employing the Bureau of Mines' liquid-liquid extraction process developed at Albany, Ore., will increase Fansteel's tantalum and columbium metal production by 50- and 150% respectively. Kawecki Chemical Co. and Kennametal Co. Inc. announced during the year they also had entered the pure metals field.

Ferrocolumbium and ferrocolumbium-tantalum production capacity increased when Molybdenum Corporation of America entered the field late in the year. Total production of those ferroalloys increased about 70% over 1955, primarily due to an increase in the use of columbium stabilized stainless steels.

Columbium consumption rose late in the year as the AEC requested bids on 15,000 lb of high purity metal.

Development of North American resources continued at a rapid pace. Kennecott Copper Co. exercised its option on Molybdenum Corporation of America's Canadian pyrochlore deposits at Oka, Quebec. Gulf Oil Corp. announced discovery of another major columbium ore deposit near Chapleau, Ontario. Largest operation in the U. S. was by Porter Brothers Corp. which operated two dredges in Bear Valley, Idaho, concentrating euxenite from placers in accordance with a contract with GSA calling for purchase of 1,050,000 lb columbium-tantalum oxides during a five-year period.

Market price for concentrate (50% combined pentoxides) containing Cb/Ta ratio of 8½:1 was $1.05 to $1.15 from Sept. 20 to the end of the year. Concentrate containing 10:1 Cb/Ta dropped to $1.25 to $1.35 Oct. 18 and remained constant to year-end.

Congress passed, in July, a new domestic minerals purchase program in which the Department of Interior was authorized to purchase columbium-tantalum-bearing minerals containing 250,000 lb combined pentoxides. Prices under the program varied according to columbium-tantalum content, but averaged $1.70 per lb combined pentoxide for 50% material. A bonus of 100% would be paid to the actual producer until Dec. 31, 1958, or until the quantity authorized was delivered.

Outlook for the two metals is encouraging. Consumption of tantalum for capacitor use may increase as much as 20 times within the next decade. The future of columbium in high temperature alloys has been assured, and the use of columbium as cladding or corrosion resistance metal in nuclear reactors may provide an even larger market. Consumption of ferrocolumbium has been increasing steadily and will continue to rise despite competition from substitutes•

Bismuth

Abbott Renick
U. S. Bureau of Mines

IN 1956 virtually all bismuth produced in the U.S. was derived as a by-product from smelting domestic copper and lead ores. As a consequence of decreased imports of unrefined bismuth metal, refinery production of metallic bismuth dropped approximately 35% under 1955. Stocks of bismuth metal held by consumers and dealers as of Dec. 31, 1956, were about 10% higher than at the beginning of the year.

Demand data on the first 9 months of 1956 indicated, particularly in the form of refined metal, a potential decrease of about 3% under the 1955 consumption. Metal products required about 70% of the total, and pharmaceuticals the remainder.

Imports of metallic bismuth were estimated at about 700,000 lb compared with 596,000 in 1955. The approximate distribution by countries of origin was Peru 47%, United Kingdom 21%, Mexico 20%, Canada 9% and Yugoslavia 3%.

The New York market price of high-quality metallic bismuth remained throughout the year at $2.25 per lb unchanged since Sept. 5, 1950•

Bismuth Statistics

(Thousands of pounds)

	1956 estimated	1955
Consumption	1,500	1,548
Imports	700	596
Exports	*	204
Avg. price, N. Y. per lb, ton lots	$2.25	$2.25

*Not available

Semi-Conductors

E. G. Knutson
U. S. Bureau of Mines

SOARING PRODUCTION of electrical devices utilizing semi-conductor materials established new records in 1956. Selenium, germanium and silicon were the preferred semi-conductor materials for the manufacture of rectifiers, transistors and diodes during the year. Selenium continued to hold its lead in the rectifier field and germanium maintained its domination of the transistor and diode production with ultra-pure silicon showing signs of becoming a serious competitor for both selenium and germanium for future expansion.

Critical supply situation for selenium was eased considerably during the last few months of 1956. Preliminary estimates indicate that production reached an all time high. Increased output was attributed to greater copper production, higher over-all recoveries, increased shipments of selenium-bearing lead flue dusts from Mexico and a larger production of secondary selenium from rectifier scrap. Principal source was the anode slimes produced during electrolytic refining of blister copper.

The supply of germanium continued to be adequate to meet the increasing demand for the metal. Principal domestic source of germanium was the zinc sulphide concentrate produced in the Tri-State and Illinois-Kentucky fluorspar mining districts. Foreign producers initiated an expansion program for germanium production scheduled for completion by the end of 1957, which should substantially increase world supply. The output of high-purity silicon kept pace with demand during 1956. Silicon has the advantage of being the most abundant solid element in the earth's crust.

Major producers of selenium were the American Smelting & Refining Co., American Metal Co., Kennecott Copper Corp., International Smelting & Refining Co. and Kawecki Chemical Co. Germanium was produced by Eagle-Picher Co., American Zinc Co., Sylvania Electric Products, Inc. and American Smelting & Refining Co. DuPont was the sole producer of ultra-pure silicon until Kawecki Chemical Co. and Sylvania Electric Products, Inc., began operations late in 1956. Five more companies have plants to produce elemental silicon in the near future.

U. S. imports of refined selenium

Selenium Statistics

(Pounds)

	1956 estimated	1955
Production	1,150,000	851,613
Imports	235,000	191,928
Total	1,385,000	1,043,541

Note: Statistics for germanium and ultra-pure silicon are not available.

were principally from Canada during 1956. Minor additions were made to the National Strategic Stockpile holdings of selenium. Imports of germanium were increased considerably over 1955 and 1954. Ultra-pure silicon was not imported in 1956.

Export quota of selenium was held at 24,000 lb.

Price of commercial-grade selenium was increased from $10.50 to $13.50 @ $15.50 per lb, effective Feb. 1, 1956. Germanium oxide was reduced from $142 to $125 per lb, Feb. 2. High-purity silicon sold from $320 to $350 per lb.

Research. In 1956 the Bureau of Mines continued its search for new sources of selenium and laboratory research to develop better and cheaper methods for recovering high-grade selenium from those ores representing a potential reserve and Battelle Memorial Institute continued to investigate the recovery of selenium from vegetation. These projects were done in cooperation with the General Services Administration. So far no deposit has been found which can be mined profitably for selenium alone.

Satisfactory results were obtained by the Bureau of Mines, using an inert fuming process for recovery of germanium from sphalerite concentrate.

Demand for a more abundant semiconductor material has led to development work on ultra-pure silicon on an industry-wide scale with very good results. Further studies and tests are being conducted.

Outlook for selenium, germanium and ultra-pure silicon, with their close ties to the tremendously expanding electronics industry, is promising for 1957. Indications are that supplies of all three of these semi-conductor materials will be adequate to meet the demands of industry. It appears that selenium and germanium production will continue at about the same level as in 1956 and the output of high-purity silicon will no doubt increase substantially as new facilities come into operation•

Rare Earths

Charles T. Baroch
U. S. Bureau of Mines

PROGRESS in rare-earth metal uses in atomic energy applications has been stimulated by AEC contracts, but many companies feel that civilian demand will soon catch up and surpass Government demand.

Most domestic mineral production came from the large California bastnasite deposit mined by Molybdenum Corp. of America and from the monazite placers in Florida, South Carolina and Idaho.

Processors included the new Davison plant (see Thorium) which sent purified rare earths remaining from its thorium operations back to the GSA stockpile and which also produced individual oxides from the residue. Mallinckrodt Chemical Works extracted uranium, Cb-Ta and thorium from the Porter Bros.' Idaho euxenite concentrate.

Molybdenum Corp. continued to specialize in mass production of metallurgical and steel additives (which contain no thorium) from bastnasite to help carry processing costs.

Price of monazite, c.i.f. U. S. ports, 55% total rare-earth oxides including thorium, massive grade, increased from 13 to 14c per lb in February. Sand grades remained at 15c for the 55% grade, 18c for the 66% grade, and 20c for the 68% grade. Prices of mixed rare-earth oxides from bastnasite and misch metal remained at $1.00 and $3.50 per lb, respectively.

Research on rare-earth elements was continued by both private and Federal agencies. Most was directed toward preparing individual rare-earth compounds, producing high-purity metals, and discovering new uses. Bureau of Mines at its Reno, Nev., station, gathered basic data on extraction and separation processes, characteristics of each element, and developed simplified analytical procedures.

Office of Naval Research awarded fundamental research contracts to Horizons, Inc., to study delay time in single crystals and the ferromagnetic properties of the different rare earths.

Many new uses were suggested and tested on an experimental scale. Rare earths were reported to be useful as catalysts in organic syntheses and polymerization, and as drying agents for paints. Experimental metallurgical uses included: addition of metal to cobalt and nickel-base alloys to give strength and durability at high temperatures; rare-earth sulphide refractories; and additions of rare-earth metals to improve titanium metal. Uses in the atomic energy field were strongly hinted but were shrouded in secrecy. Contracts were granted to 3 companies by AEC for yttrium.

Outlook. Ample supplies of rare-earth minerals are available domestically, and the future is dependent on new uses still in the experimental stage. Production is controlled by sound, capable companies and has been expanded in anticipation of growing needs. Several companies have assumed a dominant position by specializing in certain fields, but competition will unquestionably be keen for footholds in any future fields•

Platinum

Julius P. Ryan
U. S. Bureau of Mines

IMPORTS and consumption of platinum-group metals in the U. S. continued at a high rate in 1956 with domestic manufacturers using more than 50% of the world production. The bulk of U. S. supply came from foreign countries and the remainder from domestic secondary sources and from crude platinum mined in Alaska. Sustained strong industrial demand and relatively stable prices were significant features during the year. Sub-

(*Continued on p 127*)

Ferroalloys

Wilmer McInnis
Commodity Specialist
U. S. Bureau of Mines

"Chromium production reached an all-time high. Molybdenum shipments to the stockpile were diverted."

Robert W. Holliday
Commodity Specialist
U. S. Bureau of Mines

"Tungsten producers got temporary assistance from a Government purchase program to Dec. 31, 1958."

Hubert W. Davis
Commodity Specialist
U. S. Bureau of Mines

"Nickel shortage was eased by stockpile diversion. Cobalt supply was ample."

Gilbert L. DeHuff Jr.
Commodity Specialist
U. S. Bureau of Mines

"Manganese production was at a high rate for the year and foreign prices set new records."

U. S. Ferroalloys

(Short tons)

	1956 estimated		1955	
	Production	**Shipments**	Production	Shipments
Ferromanganese[1]	**1,050,000**	**1,030,000**	974,902	1,013,619
Ferrosilicon	**470,000**	**440,000**	382,699	424,744
Silvery pig iron	**439,000**	**420,000**	459,291	488,292
Ferrochromium[2]	**468,000**	**469,000**	407,703	421,867
Ferrotitanium	**7,000**	**7,500**	6,565	6,881
Ferrophosphorus	**78,000**	**77,000**	77,115	75,862
Other ferroalloys[3]	**103,000**	**102,000**	106,514	110,224
Total	**2,615,000**	**2,546,000**	2,414,789	2,541,489

[1]Includes silicomanganese and manganese briquets

[2]Low and High Carbon ferrochromium, chromium, briquets, ferrochromium silicon, chrom-X and chrom-sil-X

[3]Includes ferroboron, ferrocolumbium, ferronickel, ferrotantalum-columbium, ferrotungsten, ferromolybdenum, spiegeleisen, zirconium-ferrosilicon and miscellaneous ferroalloys

Table compiled by Hilda V. Heidrich

Nickel

Hubert W. Davis
U. S. Bureau of Mines

THE SHORTAGE OF NICKEL for civilian needs was eased substantially in 1956 by a moderate increase in Free World production and diversion to industry from scheduled shipments to the National Strategic Stockpile of 55-million lb more than in 1955. Free World production is estimated at 222,000 short tons in 1956, a gain of 3% over 1955.

A revised expansion goal aimed at providing an annual U. S. supply of 440-million lb of nickel by 1961 was announced by the Office of Defense Mobilization. Incentives to achieve the revised goal are rapid tax amortization and Government purchase contracts. ODM authorized the diversion to industry of 79.3-million lb of nickel in 1956 and also announced that all nickel scheduled for shipment to the stockpile in the first quarter of 1957 would be diverted to industry.

Production. Canadian output during the first 9 months was 134,119 short tons (up 2%), and exports were 134,259 tons (up 1.4%). Output of nickel oxide powder and oxide sinter in Cuba was 13,346 tons (nickel content) in the first 10 months of 1956 (up 6%).

Imports of nickel into the U. S. increased for the seventh consecutive year; they were 1% more in the first 9 months of 1956 than in the corresponding period of 1955. Imports from Cuba and Norway were up 28% and 21%, respectively, but those from Canada were down 4%. Canada, Cuba and Norway accounted for nearly 99% of the total. Receipts from Japan increased from 44,092 lb to 1,170,558 lb, those from West Germany from 117,161 lb to 568,547 lb, and from United Kingdom from 53,710 to 633,100 lb.

U. S. Consumption during the first 9 months was 89,600 short tons, or 13% more than in the corresponding period of 1955. Quantitywise, gains were most pronounced for stainless steels, nonferrous alloys, and high-temperature and electrical-resistance alloys, but more nickel was also used in electroplating, catalysts, ceramics and magnets. Usage for engineering alloy steels and cast irons was less.

Producers. Output by International Nickel Co. of Canada, Ltd., continued at a high rate in 1956. In addition to its own ore, Inco refined some concentrate purchased from Sherritt Gordon Mines, Ltd. Commercial production of iron ore and nickel from nickeliferous pyrrhotite at its plant at Copper Cliff, Ontario, was begun in 1956. Inco continued development at its property at Moak Lake, in the Mystery Lake area of Manitoba, where two mines, Thompson and Moak, will be opened to produce over 100-million lb of nickel annually.

Production at mines, smelter and refinery of Falconbridge Nickel Mines, Ltd, was at a high level, although mechanical difficulties reduced smelter output in June. Production of refined nickel was about 9% greater than in 1955. The Longvack mine joined the production ranks in 1956. Development work in preparing the Fecunis, Onaping and Boundary mines for production and construction of a new smelter at Falconbridge made good progress. Norway continued expansion at a refinery designed to raise nickel production to 55-million lb annually. Exploration of nickeliferous lateritic deposits in the Dominican Republic was continued at an accelerated rate. Exploration was also continued at Populus Lake in the Kenora area of Ontario.

Production at the refinery of Sherritt Gordon Mines, Ltd., at Fort Saskatchewan, Alberta, was at a higher rate in 1956 than in 1955. With cessation of concentrate shipments to Inco at the end of March, the scale of production at the mines and mill at Lynn Lake, Manitoba, was reduced to bring them into line with the refinery production rate of 20-million lb of nickel annually. However, a test made in August demonstrated that the refinery had a surplus production capacity which can be used to treat outside concentrate on a toll basis.

Shaft sinking was started at the Farley property at Lynn Lake and geophysical work and diamond drilling were done on properties in the Mystery-Moak area of Manitoba, but results were inconclusive.

Nickel Statistics

(Short tons)

	1956 estimated	1955
United States		
Imports	**145,000**	142,631
Consumption	**125,000**	109,304
Canada		
Production	**178,000**	174,581
Exports	**177,000**	173,880
Cuba		
Production	**16,000**	15,138
Price per lb electrolytic nickel in carlots, Port Colborne, Ont. including duty of 1¼c	**64½@74c**	64½c

Note: Some nickel diverted from the U. S. stockpile was sold at a higher price

Output by Nickel Processing Corp. at the U. S. Government-owned nickel plant in Cuba established a new high in 1956 and was about 5% greater than in 1955. Record production was achieved despite the handicap of an "in-progress" expansion program to increase capacity by 75% in December. In June, National Lead Co. began producing metallic nickel at Crum Lynne, Pa., from Cuban nickel oxide sinter under a contract with GSA.

Freeport Sulphur Co., near New Orleans, La., completed favorable pilot plant tests on a simplified process for producing nickel and cobalt from deposits at Moa Bay, Cuba. In Cuba the company plans to produce a high-grade bulk nickel-cobalt concentrate, which will be shipped to the U. S. where it will be reduced by a hydrogen process to yield separate products of high-purity nickel and cobalt.

Hanna Nickel Smelting Co. placed two additional furnaces in operation during the early part of 1956 and, consequently, production of ferronickel during the first 10 months about doubled that in the corresponding period of 1955, when two furnaces were operated. Production of ferronickel during the first 10 months of 1956 was 18,908,239 lb containing 8,634,150 lb Ni. The mine and smelter, which are near Riddle, Ore., did not operate in August because of a strike. Some ore was shipped to Santa Rosalia, Mexico, for experimental work.

Outlook. Free World production of nickel will probably again increase moderately in 1957. Industrial demand for nickel in 1957 probably will exceed the 1956 consumption rate. This demand only can be met by diversion to industry from scheduled shipments to the stockpile of larger quantities than in 1956.

Manganese

Gilbert L. DeHuff Jr.
U. S. Bureau of Mines

ORE SUPPLY was one of the major concerns of U. S. consumers during 1956, with foreign prices reaching new highs. Domestic production, in large part for Government account at premium prices, exceeded 1955. The "carload lot" program of GSA accounted for metallurgical ore production not supplied by the two leaders, Manganese, Inc.'s Henderson, Nev., plant and Anaconda at Butte. The GSA tonnages from the Western states were appreciable for the first time as the Butte-Philipsburg program for purchase of domestic ores received both carbonate and oxide ores.

Duration of the program was changed from June 30, 1958 or delivery of 19-million long dry ton units, to Jan. 1, 1961 or delivery of 28-million. In October, those regulations dealing with participation, deliveries and acceptance were further amended.

Foreign ores felt the pressures of reimposed export duties on Indian shipments, entry of the Indian State Trading Corp. into the market, high ocean freight rates and the Suez flare-up. Freight rates as high as $29 per ton were reported for Indian ore cut off from use of the Suez Canal. Prices of Indian ore of 46 to 48% Mn content increased from $1.12 to $1.17 per long ton unit (c.i.f. U.S. ports, duty extra) in January through increases in August until the year-end saw them at $1.54 to $1.55.

India, as a major source, was followed by Gold Coast, Union of South Africa, Cuba and Brazil, all five accounting for three-fourths of U. S. imports in September. Mexico and Belgian Congo in equal proportions divided more than half, of the remaining fourth.

Total U. S. imports of ferromanganese through September were 195,000 short tons, with major suppliers including Canada, France, Japan and West Germany.

Manganese Ore Statistics

(Thousands of short tons)*

	1956 estimated	1955
United States		
Production	325	285
Consumption	2,200	2,100
Exports	6	6
Imports	2,100	2,088

*Includes all ore 35% or more Mn

U. S. production was highlighted by shipping of manganiferous ores for industrial use from Minnesota. Some 90% of production was involved. Remainder came from New Mexico and Montana.

Manganese Chemicals Corp. converted its operations at Riverton, Minn., from production of metallurgical nodules to production of synthetic battery ore. Low grade manganiferous material from the Cuyuna Range comprised the feed for the firm's ammonium carbamate leaching plant. Trout Mining Division of American Machine & Metals, Inc. continued to produce battery concentrate at Philipsburg, Mont.

The steel strike which lasted through July and into August cut normal manganese ore consumption, however, production of ferromanganese for the first nine months amounted to 649,000 short tons, indicating an estimated 900,000 tons for the year. Demand for electrolytic manganese increased with growing recognition of the Mn 201-202 stainless steels in industry.

Ferromanganese prices were raised to $215 per net ton in April and to $235 per ton in September. An increase announced for spiegeleisen in October, following an earlier increase in April, resulted in quotes of $99.50 per gross ton for the 19 to 21% Mn grade.

Research. Experimental work by USBM on sulphur dioxide leaching of wad ores obtained good recoveries of manganese, as did ammoniacal-ammonium carbonate leaching of reduced manganiferous materials from the southern district of Aroostook County, Me. Pellets of manganese oxide, of good physical structure containing 54% Mn, 1.9% Fe and 0.01% S, were produced from Cuyuna Range manganiferous carbonate slate in a 6-in. dia shaft furnace by the sulphur dioxide-air roast process developed by the Bureau at the Minneapolis station.

The Symposium on Manganese Deposits of the 20th International Geological Congress, held in Mexico City during the first week of September, accepted 61 papers from 40 countries during the sessions.

The USBM has issued RI's describing beneficiation and smelting of highly siliceous ores, chloride volatilization process for Aroostook low-grade ores, a mineral dressing study of western Arkansas deposits, operations of Manganese, Inc. at Three Kids, Nev., and investigations of deposits in Arizona, Arkansas, California and Tennessee.

Pilot plant testing of the Bruce Williams leaching process proceeded under terms of the contract between GSA and Ores Beneficiation, Inc.; and testing of the Udy electric furnace process was carried out by Strategic-Udy Metallurgical & Chemical Processes Ltd. in its pilot plant at Niagara Falls, N. Y.

Outlook. Another active year for manganese in 1957 may be highlighted by a higher rate of domestic production•

Molybdenum

Wilmer McInnis
U. S. Bureau of Mines

U. S. PRODUCTION of molybdenum, about 90% of total world output, during the first 9 months of 1956 was 43.4-million lb, 5% less than the quantity produced in the same months of 1955. Production from molybdenum mines was 13% lower but by-product recovery was 15% higher. Decrease in output from mines operated chiefly for molybdenum was mostly due to treatment of a larger quantity of low-grade ore that was mined to avoid its permanent loss. A year free of work stoppages, such as occurred at several copper mines in 1955, and the recovery of molybdenum contained in the copper ores taken from the Silver Bell and San Manuel mines in Arizona, were the major factors in the increased

U. S. Molybdenum Statistics

(Thousands of lb contained Mo)

	1956 estimated	1955
Concentrate:		
Production	58,500	61,781
Consumption	41,500	38,799
Exports[1]	16,000	14,580
Primary products:[2]		
Production	41,000	37,774
Shipments: (total)	40,500	38,606
Domestic	38,300	35,935
Export	2,200	2,671
Consumption	38,000	*

[1]Includes roasted concentrate
[2]Comprises ferromolybdenum, molybdic oxide and molybdenum salts and metal
*Not available

by-product molybdenum production.

All U. S. production was from mines in Colorado, Utah, Arizona, New Mexico, California and Nevada. About two-thirds was from the Climax Molybdenum Co. in Colorado and over three-fourths of the remainder was by-product from copper ores of Kennecott Copper Corp.'s Utah Copper Div., at Bingham.

Climax added a new unit to its mill that increased rated milling capacity to 32,000 tpd ore. Unit started operation in August and another milling and flotation unit of the same capacity being installed is expected to be in operation early in 1957.

Foreign production in 1956 is expected to be about 10% below output in 1955. Braden Copper Co., Sewell, Chile, continued to be the major foreign producer but output during the first half of the year decreased 27% compared with the same period in 1955. Molybdenite Corp. of Canada, Ltd., increased milling capacity at La Corne mine in Quebec, and built a plant to convert molybdenite concentrate to molybdic oxide. La Corne (sole source of molybdenum in Canada in 1956) has an output of about 850,000 lb. Production in Norway, Japan and other producing countries is not believed to have changed significantly.

Domestic concentrate consumption in 1956 was highest since 1943. Consumed concentrate averaged about 90% MoS_2, and virtually all was converted to molybdenum trioxide in plants located at Miami, Ariz., Pine Creek, (near Bishop), Calif., Denver, Colo., Canton, Ohio, and Langeloth and Washington, Pa. Consumption during the first 9 months totaled 31,368,000 lb contained molybdenum, 26% higher than the quantity consumed during the same period of 1955.

Production and shipments of molybdenum products during the first 8 months of 1956 were 13% and 11%, respectively, greater than in the same months of 1955. An estimated 38.3-million lb of molybdenum contained in products was consumed in the U. S. in 1956, of which is estimated that 33-million lb went into ferrous alloys, 2-million lb in high temperature alloys, 0.9-million lb as metal, and 2.1-million lb in chemicals and uses such as magnetic alloys, plant foods and research.

Climax Molybdenum doubled its capacity to produce high purity molybdenum trioxide (used principally in production of metallic molybdenum) and the Shattuck Chemical Co. increased its capacity to convert molybdenite to technical grade molybdenum trioxide.

Research on molybdenum-base alloys for use in high temperature applications was continued by industry and the Bureau of Mines continued its research on the producton of massive molybdenum by bomb reduction.

Foreign trade in molybdenum during 1956 was higher than the previous year. U. S. exports of Mo in concentrates (including roasted concentrates) totaled 12,356,061 lb during the first 9 months of the year compared with 10,958,089 lb during the same period of 1955. The major importing countries were: West Germany 32%; United Kingdom 19% and France 18%. Exports of molybdenum products were not classified separately during the first half of 1955. No U. S. imports of molybdenum concentrate were reported through October.

Molybdenum Prices In 1956

(Price per pound of contained molybdenum, f.o.b. shipping point)

	Jan. 1	Dec. 31
Concentrate, 90 to 95% MoS_2		
Climax, Colo.	$1.10*	$1.18*
Washington, Pa.	1.15	1.23
Ferromolybdenum (58 to 64% Mo) 5,000 or more lb lots;		
Powdered	1.66	1.74
Other sizes	1.54	1.68
Calcium molybdate ($CaO\text{-}MoO_3$) lump	1.34	1.42
Technical molybdic trioxide (MoO_3)		
Lump, bagged	1.30	1.38
Lump, canned	1.31	1.39
Briquets	1.33	1.41
Metal-carbon reduced powder,		
Washington, Pa.	3.20	3.35

* Plus cost of container.

Outlook. With increased milling capacity at Climax and by-product recovery of molybdenite at Chuquicamata, Chile, due in the first half of 1957, molybdenum production should meet both domestic and foreign demands. Total consumption will follow alloy steel production. The use of molybdenum in high temperature alloys, as metal, and in nonmetallic applications such as catalysts, lubricants and fertilizers is expected to increase in 1957. Exports to Western Europe should increase, but because of a new molybdenum products plant in Canada, exports there will very likely decrease•

Chromium

Wilmer McInnis
U. S. Bureau of Mines

DOMESTIC PRODUCTION (mine shipments) of chromite during the first 9 months of 1956 totaled 120,000 short tons, compared with 121,000 tons during the same period of 1955. All production was from mines in Alaska, California, Montana, Oregon and Washington: virtually all shipments were sold to the Government at incentive prices.

Kenai Chrome Co. was the sole producer in Alaska, shipping 4,010 short dry tons of metallurgical-grade ore from its Star Four mine on Red Mountain, Kenai Peninsula, during the first three quarters of the year. The company had planned to ship low-grade ore to its newly constructed concentrator which was expected to

Chromite Prices—1956

(Long tons)[1]

Source	Cr_2O_3 %	Cr:Fe ratio	Jan. 1	Nov. 15
Southern Rhodesia	48	3:1[2]	$45.00 to $46.00	$55.00 to $58.50
Southern Rhodesia	48	2.8:1	42.00 to 43.00	52.00 to 56.00
Southern Rhodesia	48	...	33.00 to 35.00	46.00 to 49.75
South Africa (Transvaal)	48	...	31.00 to 32.00	38.00 to 39.00
South Africa (Transvaal)	44	...	23.50 to 24.50	25.50 to 27.50
Turkey	48	3:1[3]	52.00 to 53.00	59.00 to 61.00
Turkey	46	3:1[3]	49.50 to 51.00	56.00 to 58.00
Pakistan	48	3:1	49.00 to 50.00	52.00 to 53.00
Domestic	48	3:1[2]	115.00	115.00
Domestic	48	3:1[4]	110.00	110.00

[1]Foreign operations are on a dry basis, subject to penalties if guarantees are not met, f.o.b. cars U. S. east coast ports. Rhodesian prices are on a long-term contract basis. Turkish and Pakistan prices are nominal. Domestic prices are those paid by the Government, delivered, Grants Pass., Ore.
[2]Lump ore.
[3]Lump and concentrate.
[4]Concentrate and fines.

commence operations by December, but a freeze-up during the second week of September prevented movement of the ore from mine to mill. During the first three quarters of 1956, over 50% of the ore reported shipped from mines in California was from the Lambert, Butler Estate No. 1, and Sweetwater mines and over 70% of the shipments from mines in Oregon was reported shipped from the Oregon Chrome mine, in Josephine County and the Haggard and New Mine in Grant County.

Montana production, 75% of the domestic total in the first three quarters, was from the American Chrome Co. Mouat mine in Stillwater County. This ore was beneficiated to yield a concentrate averaging about 38% Cr_2O_3, which was delivered to the Government under terms of a contract for 900,000 short tons over an eight-year period.

Chromium Products Prices—1956

(Per pound contained Cr)

Ferrochromium, carload lots, lump, bulk, f.o.b. destination Continental U. S.	Jan. 1	Nov. 15
High-carbon (4 to 9% C, 65 to 70% Cr)	26.25c	27.75c
Low-carbon (0.06% C, 67 to 72% Cr)	36.50c	39.50c
Special (0.01% C, 63 to 66% Cr)	32.75c	35.75c
Chromium 97% grade, 0.5% C	$1.25	$1.29
9 to 11% C	$1.34	$1.38
Electrolytic com. grade 99% min. f.o.b. Niagara Falls, N. Y.	$1.25	$1.29

Total chromite consumed in the first nine months in producing the alloys and metals included 687,000 tons metallurgical-grade ore and concentrate that averaged 48% Cr_2O_3, 87,000 tons chemical-grade 44.1% Cr_2O_3, and 59,000 tons refractory-grade 35.6% Cr_2O_3. Seventy per cent of the metallurgical-grade chromite had a Cr/Fe ratio of 3:1, 23% less than 3:1, but at least 2:1, and 7% had less than 2:1 ratio. The refractory industry consumed 345,000 tons of refractory-grade chromite in the manufacture of refractory brick and other refractory mixes, and the chemical industry used 121,000 tons in the manufacture of 90,000 tons of chromium chemicals sodium bichromates equivalent.

Consumption of chromium alloys and metal during the first three quarters of 1956 totaled 208,000 tons compared with 222,000 tons during the same quarters of 1955. Of the quantity consumed, 61.8% was used in the production of stainless steel, 32.3% in other alloy steel (including high speed), 4.2% in high temperature alloys, and 1.7% in other uses. High- and low-carbon ferrochromium comprised 72% of the total alloys and metal consumed.

Government participation was mostly directed toward increased chromite supply. By administrative action, the Domestic Chrome Purchase Program was amended to extend the expiration date to June 30, 1959 and to allow acceptance of carlot shipments at points other than Grants Pass, Ore., the latter was in effect a price increase for some shippers. The Department of Agriculture bartered surplus farm commodities for chromite, ferrochromium and chromium. Bureau of Mines research was mostly directed toward utilization of sub-grade domestic ores. Reports of Investigations on John Day Chromites, Grant County, Oregon Exploration and Utilization Studies; Electric Smelting of Low-Grade Chromite Concentrates: Chromium Metal Electrowinning; and Preparation of High-Purity Electrolytic Chromium were prepared by the Bureau.

Stocks of chromite at consumers plants at the end of September were equivalent to a 8-month supply. Stocks held by metallurgical and refractory users increased 1 and 33%, respectively, but chemical users stocks were 14% lower than at the end of 1955.

Prices of foreign chromite ores and concentrate increased from about $1 to $12 a long ton, depending upon the grades and sources. The price of high-carbon ferrochromium (4 to 9% C, 65 to 70% Cr) was increased by 1.5c a lb of contained chromium; low-carbon ferrochromium by 3c a lb; and all grades of metal were quoted at 4c a lb higher than at the end of 1955.

Prices of chromium products are shown in the table at bottom left, Jan. 1 through Dec. 31.

United States imports of chromite in 1956 were at a rate higher than in any year except 1953. During the first three quarters, imports totaled 1,616,000 short tons. Of the total ore received through September, 861,000 tons was metallurgical-grade (average 46.9% Cr_2O_3), 574,000 tons refractory-grade (33.3% Cr_2O_3), and 182,000 tons chemical-grade (43.9% Cr_2O_3). Metallurgical-grade ore came chiefly from Turkey (43%), Federation of Rhodesia and Nyasaland (28%) and the Union of South Africa (14%). Republic of the Philippines shipped 88% of the refractory-grade ore and all chemical-grade came from the Union of South Africa.

World review indicates chromite production in 1956 was about 10% higher than the estimated 3.9-million tons produced in 1955. Transportation in Rhodesia, Union of South Africa

Chromite Statistics

(Thousands of short tons)

	1956 estimated	1955
U. S. production (mine shipments)	150	153
Imports	2,100	1,828
Total consumption	1,800	1,584
Metallurgical	1,140	994
Refractory	500	431
Chemical	160	159

and Turkey continued to hamper shipments to port: it was reported that stockpiles of chromite at mines in Rhodesia and the Union of South Africa totaled around 1-million tons. Philippine production during the first 9 months was about 25% higher than in the same months of 1955.

Outlook. More extensive use of chromium in high temperature alloys coupled with an expected increase in production of stainless and other alloy steels may boost domestic consumption of metallurgical-grade ore by perhaps 10%. Domestic production of chromite is not expected to increase significantly•

Tungsten

Robert W. Holliday
U. S. Bureau of Mines

DOMESTIC PRODUCTION in 1956 was second highest in history and consumption was the highest since 1951. General imports were estimated at 8% above 1955 and third highest on record.

Concentrate output remained high despite a 3-month interruption in acceptance by the U. S. Government. Purchase authorized under Public Law 429, 82nd Congress, was completed about June 1, 1956 and additional purchase, authorized under Public Law 733, 84th Congress, did not begin until Aug. 31 although acceptance was retroactive to July 20. The new purchase program will terminate when 1,250,000 short ton units of tungsten trioxide have been delivered or on Dec. 31, 1958, whichever occurs first.

(Purchase was again discontinued early in December pending provision of additional funds by Congress—Ed.)

Because of the market situation outlined above, production was at a record rate for the first six months, declined during June and July and remained at a low level during August. Activity increased in the late months of 1956 but did not again reach a record rate. A provision of the new law limiting Government purchase to 5,000 units per month from any single mine resulted in some sales of domestic production in the world market.

Leading state in production was Nevada, followed by California, North Carolina, Colorado, Montana and Idaho. These six states produced more than 95% of the total and five other states accounted for the remainder. Scheelite comprised 70% of production and hübnerite, wolframite and ferberite 30%.

Consumption of concentrate for the year was at a high rate although some processors also encountered serious mid-year marketing difficulty. The steel strike, which lasted through July and the first week of August, brought a substantial decline in consumption.

U. S. Tungsten Concentrates

(Thousands of lb of contained tungsten)

	1956 estimated	1955
Production	13,600	15,669
Consumption	9,600	8,961
General imports	22,400	20,789

An estimated 47% of 1956 consumption was in steel and other alloys; 34% in carbides; and 14% in pure tungsten uses (wire, rod and sheet). Consumption of home, or recycled, scrap is a usual practice although data are not compiled. Importance of purchased scrap is indicated by the volume of imports listed in the following paragraph.

U. S. imports of concentrate in the first 9 months of 1956 were 16,839,000 lb (metal content) compared with 15,201,000 lb for the same period in 1955. Apparently the increase in consumption by industry plus entries into bonded warehouses exceeded curtailment of purchasing by GSA. Imports from Belgian Congo, Bolivia, Canada, France, Japan, Portugal and Spain declined; those from Argentina, Australia, Brazil, Burma, Chile, Korea, Peru and Thailand increased.

A 25% ad valorem duty on scrap tungsten (re-imposed in July) is expected to slow the upward trend in imports which metal, alloy and carbide scrap have enjoyed. For the first six months of 1956, the U. S. had imported 416,760 lb (gross weight) compared with 347,546 for the whole of 1955.

Imports of ferrotungsten for the first 9 months were 26% higher than the same period of the previous year, totaling 595,000 lb tungsten content. Leading exporters were Japan, Portugal, Austria, Sweden, United Kingdom, Netherlands and Belgium-Luxemburg.

Prices paid by the Government for concentrate produced in the U. S. during 1956 were $63 per short ton unit of WO_3 until the "old" purchase program ended and $55 per unit, retroactive to July, for concentrate purchased under provisions of the "new" authorization. Various negotiated prices were paid by the Government, to foreign producers, under long term contracts. Open market prices varied little during the first 9 months, but declined in the last quarter to end at the following prices on Dec. 31: $55 per short ton unit, f.o.b. milling point; $27.25 to $27.75 imported c.i.f. U. S. ports duty extra for wolfram and scheelite; and 220s bid, 225s asked for London, per long ton unit of WO_3 (wolfram).

World production, based on 9 months data, was not appreciably different from that of 1955 and again depended on ability to market as well as capacity to produce. Greatest Free World production by far was in the U. S., followed by Bolivia, Portugal and Korea, probably in that order. Start of construction of an 80-tpd chemical processing plant in Korea was reported, with completion scheduled for mid-1957. Continued rehabilitation of the Mawchi mine in Burma, the gradual curtailment of purchasing for the U. S. stockpile and the possibility that tungsten concentrate from China might enter the Free World market were other factors affecting world production in 1956. Installation of new equipment enabled Argentine output to reach 2-million lb contained tungsten, in the first three quarters of 1956.

Research and investigation of mineral deposits, mining methods and beneficiation by the Bureau of Mines continued and preliminary studies of methods for secondary recovery of tungsten were underway during the year.

Research sponsored by the Tung-

sten Institute (conducted by the Stanford Research Institute) was directed toward new and expanded utilization of tungsten with particular attention to development of a tungsten-base alloy for high temperature applications such as blades and vanes of jet aircraft. The contract initiated in November 1955 on a 9-month basis was recently extended indefinitely.

Outlook for the domestic mining and milling industry is favorable through 1957 and at least part of 1958 due to the Government purchase program. The price per unit will be lower than that of recent years, but at $55 will be nearly double world market prices of 1956. Government sales limitation of 5,000 short ton units per month per mine will restrict only a few of the largest operators, and they will have freedom to sell excess production on the open market.

Consumption also can be expected to increase as population and steel production increase, but also as needs and uses for the exceptional properties of tungsten are developed. Valuable properties include strength and hardness at high temperature.

Imports can be expected to decline as contracts for the Government stockpile are completed. However, as foreign productive capacity is released there will be increased effort, through lowered prices, barter agreements or other means to continue selling in American markets•

Cobalt

Hubert W. Davis
U. S. Bureau of Mines

Cobalt Statistics

(Pounds)

	Metal		Oxide (gross wt)	
	1956 9 months	1955	1956 9 months	1955
U. S. production	3,740,491	3,655,389	465,418	610,120
U. S. imports	9,998,380	15,535,040	618,450	1,072,950
Belgium-Belgian Congo	8,324,593	13,327,929	618,450	1,071,350
Canada	887,482	1,347,442	—	—
West Germany	323,817	606,863	—	1,600
Norway	347,427	250,271	—	—
Price per lb	$2.60*	$2.60	$1.96	$1.99

*Effective Dec. 1, 1956, price of metal was reduced to $2.35 per lb and oxide to $2.50 per lb of contained cobalt.

FREE WORLD PRODUCTION of cobalt increased for the seventh consecutive year, but the six-year uptrend in U.S. imports was reversed. Free World production is estimated at 16,000 short tons in 1956, compared with 14,600 tons in 1955.

U. S. imports in the first 9 months were 17% less than during the corresponding period of 1955. Receipts of metal from Belgium and Belgian Congo were down 15% and from Canada and West Germany 4- and 26%, respectively, but the losses were partly offset by a gain of 104% from Norway. Imports of oxide from Belgium during the first 9 months declined 19% from those in the corresponding period of 1955.

U. S. supply. Production of cobalt metal for 9 months was 47% more than in the corresponding period of 1955 but imports declined 13%. Production and imports of oxide dropped 8% and 19%, respectively. Production and shipments of salts and driers during the first 9 months were as follows: (Co content in pounds)

	1956 9 months	Change
Production:		
Salts	265,921	−12%
Driers	422,466	− 3%
Hydrate	179,473	+30%
Shipments:		
Salts	271,779	− 6%
Driers	414,965	− 5%
Hydrate	141,674	+ 6%

Consumption was 7,281,000 lb during the first 9 months compared with 7,257,000 lb in the corresponding period 1955. Cobalt-chromium-tungsten-molybdenum alloys represented 34% of total consumption, but the quantity used was 6% less than in 1955. Magnet alloys took 29% (up 4%).

Concentrate producers from domestic ore included Bethlehem Cornwall Corp., Calera Mining Co. and National Lead Co. Production (cobalt content) was 2,886,000 lb in the first 10 months compared with 2,063,000 lb in the corresponding period 1955.

Garfield (Utah) refinery of Calera Mining Co. produced 44% more cobalt metal in the first 10 months of 1956 than in the corresponding period of 1955. Research was begun to develop a process for producing high-purity electrolytic cobalt.

African Metals Corp.'s refinery at Niagara Falls, N.Y., operated at about the same rate as in 1955, and the refinery of Pyrites Co. at Wilmington, Del., at a slightly higher rate. National Lead Co. continued to perform tests and make development runs at its refinery at Fredericktown, Mo., but much more cobalt metal was produced than in 1955.

Operating problems at the cobalt unit of Sherritt Gordon Mines, Ltd., at Fort Saskatchewan, Alberta, were solved satisfactorily and the plant produced some specification cobalt metal. During the second quarter, however, cobalt production was suspended while the circuit was used as a pilot plant on a foreign concentrate. Work was completed during the third quarter and the circuit was put back on cobalt production.

International Nickel Co. of Canada, Ltd., Port Colborne, Ont., Falconbridge Nickel Mines, Ltd., Kristiansand, Norway, Rhokana Corp., Nkana, Northern Rhodesia, and Union Miniere du Haut-Katanga, Belgian Congo, operated at higher rates than in 1955.

The new flotation concentrator of Chibuluma Mines, Ltd., near Ndola, Northern Rhodesia, began producing cobalt concentrate May 6. The concentrate will be converted into a 10% cobalt matte at a plant under construction at Ndola and expected to begin operation in mid-1957. Matte will probably be shipped to Europe for refining.

Outlook. Free World production of cobalt is expected to continue at a high rate in 1957, assuring adequate supplies for industry and stockpiling•

Non-Metallics

Walter A. Rukeyser
Consulting Engineer
Montreal, Que.

"Asbestos production is geared to consumption. Last year probably saw a slight consumption decrease."

Robert D. McDougal
Commodity Specialist
U. S. Bureau of Mines

"Fluorspar imports increased over 1955. Industrial consumption set a record, reflecting industry growth."

Reginald Rowand
Production Manager,
Baroid Division,
National Lead Co.

"Barite production was up again in 1956. Greater expansion is likely."

Nelson C. White
Vice President, Potash
Division, International
Minerals & Chemical Corp.

"Potash demand leveled off as producers expanded, continued exploration."

William S. Steele
President
American Vermiculite Corp.

"Vermiculite production and sales continued the same level as industry outlets became more diversified."

H. F. Dengler
Export Sales Manager, International Minerals & Chemical Corp.

"Phosphate production for the world hit 30-million tons: U. S. share is 50%."

Brooke L. Gunsallus
Commodity Specialist
U. S. Bureau of Mines

"Feldspar output, both as crude and ground, is estimated to have increased about 10%."

Langbourne M. Williams
President
Freeport Sulphur Co.

"Sulphur production and consumption attained new highs. Mexico and Canada added to the world supply."

Leonard P. Larson
Commodity Specialist
U. S. Bureau of Mines

"Gypsum felt the drop in home building in 1956. Nonresidential building might offset the loss."

Milford L. Skow
Commodity Specialist
U. S. Bureau of Mines

"Mica demand showed growth of electronics: strategic sheet mica still leads substitutes."

Asbestos

Walter A. Rukeyser
Consulting Engineer

DOLLAR VALUE of Canadian asbestos shipments for 1956, based on the price increase posted early in the year, should bring the year's total to well above the $100-million mark for the first time in industry history, despite a decline in volume shipped. Dollar value last year was $96,191,317.

In 1956, when new housing units declined by about 17% and new-auto sales by 20%, 10-months' shipments of Canadian asbestos were down a meager 3%.

For September the drop was a severe 13% from the preceding year; in October (the last month for which Dominion Government statistics were available at the time of writing) an improved 7%. November and December, with automobile sales again at a peak, may bring Canadian shipments for the full year to something over 1-million tons, or quite close to the record 1955 figure.

Though Quebec shipments were down almost 4% for the 10-months' period, those from the other producing areas, Ontario and British Columbia, were up nearly 6%. The 4,000 tons produced per month outside of Quebec comprise Group 3 and 4 fibers in the main so that the sales of spinning fibers from Canada at least held their own last year. Surprisingly, despite strikes in the asbestos-cement industry, 4th group shingle grades registered a healthy advance in 1956, being the only group which went contrary to the diminished trend in all other milled grades.

Due to strikes and the reduced number of housing units constructed in the year just passed, the year by year increase in the shipment of shorts was reversed and the final figures for 1956 may show the drop to be as great as 10%.

Again taking 1938 as 100, the U. S. gross national product moved up from 428 to 458 on dollar-value. The spinning, shingle and paper stock shipments were up from 210 to an estimated 232 (on a tonnage basis); but the shorts were down from 540 to probably something below 500. Despite the reversal in trend of the latter grades, they still show their superior acceptance in terms of the increase in national product and relative to shipments of longer fibers from Canada. The statistics again emphasize the industry's ability to produce greater amounts of spinning, shingle and paper grades than present markets can absorb. In fact, in 1956, all grades were in abundant supply, inventories were ample and a "buyers' market" was distinctly in evidence.

For the above reasons, the across the line increases in the prices of Canadian fibers posted Jan. 1, 1956 may have come as something of a surprise in many quarters. (See cost table.)

Thus in 1955, despite the sharp increase in the tonnage mined to produce a ton of mill-feed, a ratio of approximately 60:40, the profit per ton milled rose 34c or 10% as compared to the previous year. In 1955 the average selling price of fiber per ton was $90.40. In 1956, with the increase, the estimated comparative figure is about $100.00. It is not believed that any increases in costs during 1956 will have entirely absorbed this differential.

No new mills were placed in production last year. However, expansion of Canadian facilities are still under way. Lake Asbestos (American Smelting and United Asbestos) has made enormous progress in its $35-million program to drain Black Lake preparatory to open-pit mining with a fiber objective of slightly over 100,000 tons per year. Mill erection is well under way and production should commence in 1958. The fiber produced apparently is not tied to a parent consumer.

Two other new mills, now in the planning stage, will have their production tied to owner-manufacturers: National Gypsum, a newcomer in the field of asbestos mining is to erect a 200-tph mill and Philip Carey in 1958 will open its new mine and 150-tph plant. Johns-Manville is adding four new producing lines to its present new mill, a substantial increase to the twelve now operating. These four projects should mean at least 400,000 tons additional fiber output in Quebec alone, all of which should be available before 1959. In view of the expansion in Africa and the ability of the USSR to sell on world markets (55,000 tons of 3 and 4 group fiber in Europe in 1956) it will be interesting to see if such tonnages can be absorbed, particularly if the rate of increase of the boom in the U.S. has leveled off.

To meet this accelerated production the Canadian mines are now estimated to have some 575-million tons of proven reserves with a further 379-million indicated, but not thoroughly tested. In the past 8 years alone, 250-million tons have been discovered and the ultimate potential has by no means been exhausted. With the additional mill capacity now under construction and envisaged, the presently known ore reserves appear to be sufficient for another 30 to 40 years.

Two new Canadian finds are now under development and give promise of becoming large potential producers. The first of these, in the Yukon, is under option to Conwest Exploration, the parent company of Cassiar, which has become such a successful shipper of long, low-iron fibers from British Columbia. New property, about 30 miles from Dawson City, will enjoy good transport and other facilities despite its far north location. The second, situated on the Burlington Peninsula in Newfoundland is part of a 1,575-sq mile concession held by Advocate Mines (associated with the Michael J. Boylen interests). Work done to date indicates a favorable serpentinized belt extending for several miles. A large mill is said to be in the planning stage.

Recently published information concerning this deposit supplies the following: diamond drilling has developed some 13-million tons of ore grading an estimated $8.50 per ton, based on visual analysis of the cores. Three large bulk samples of 600 tons each have been milled by Canadian Johns-Manville and the two samples completed to date yielded $21.53 and $14.85 per ton respectively. R. J. Isaacs, consulting engineer for the company, is quoted as anticipating a 5,000-tpd operation costing some $17.5-million including a hydroelectric power development.

Little new information seems to have been forthcoming during the past year concerning Chibougamau Asbestos. However, best information available would indicate that plans for placing the deposit in production are still being formulated.

In western Quebec, Eastern Asbestos has ordered the equipment for a 250-tpd mill; erection to commence immediately. Steel framework for the main mill building and much of the machinery has already been delivered to the site at Notre Dame de la Salette.

23 miles north of Buckingham, to which it is now joined by a first-class paved highway. This deposit, which is of the Arizona type with serpentine derived from a dolomitic limestone, will produce an extremely low-iron (iron-free) almost snow-white fiber having high strength and other excellent characteristics.

Another new development in the Thetford district is the purchase of the mill and mine of Continental Asbestos by Cameron Copper. Cameron is developing two lots lying adjacent to and between the new Johnson's mine and the Beaver (Asbestos Corp.) on which diamond drilling and underground exploration have indicated 4.5-million tons of open-cut ore in one corner of the property alone, with a total of 12- to 13-million to a depth of 750 ft. Grade, from extensive milling of bulk samples appears to approximate the average of the district. Slightly over 50,000 cu yd of overburden were removed last Fall and ore is being trucked to the former Continental mill, a distance of about 10 miles at a cost of 65c per ton on a 300- to 500-tpd basis. Mill runs to date have shown the fiber to be of typical Thetford quality and considerably more 3rd group material is being produced from power-shovel ore than was indicated in any previous test run on shaft and drift muck or from drill-core analyses.

Manufacturing facilities. Johns-Manville has announced plans for the construction of two new plants for the manufacture of asbestos-cement pipe at Stockton, Calif. and Denison, Tex.; two factories for the making of insulating board at North Bay, Ontario and Klamath Falls, Ore.; a floor tile plant in Louisiana, a hardboard plant at Natchez. Flintkote also has announced a $20-million expansion of manufacturing facilities while National Gypsum is entering the brake-lining field and Thermoid has acquired a new plant in Mexico City. Eternit of Italy is building a $2-million factory near Vancouver.

In Africa there appears little news to report, with production of chrysotile, amosite and "blue" running but little higher than in 1955. The main addition to production from this continent is the 20,000 tons of fiber being produced annually by the new mill of Rhodesian Asbestos (controlled by Canadian Johns-Manville). However, results from this project have not been up to expectation and fiber from other localities has had to be brought in for purposes of blending and upgrading. Southern Rhodesia's output is now in the order of something above 10,000 tons per month as opposed to the 105,000 tons reported for all of 1955. In Eastern Transvaal, Star Asbestos completed a new mill incorporating a purportedly new method of treatment. The present capacity is 300 tons of fiber monthly with an immediate increase to 600 anticipated.

Canadian Asbestos Mining Costs

(Except plant replacement, renewal, expansion, ore depletion)

	1955	1954	
Labor and employees	$28,116,049	$24,850,100	
Fuel and electricity	5,117,137	4,130,806	
Supplies and containers	11,180,264	9,924,166	
Taxes (all)	9,240,496	9,184,997	
Workmen's compensation	392,692	406,147	
Silicosis and unemployment insurance	184,824	184,923	
Total	$54,231,462	$48,681,139	
Tons mined	17,696,357	14,394,571	+23%
Tons milled	12,427,002	11,394,571	+9%
Gross profit	$45,409,636	$37,728,073	+20%
Profit per ton milled	$3.65	$3.31	+10%
Profit to sales	45%	44%	+1%

Canadian Asbestos Shipments by Grades

(Including any for own use—short tons)

	10 months		October	
Quebec	1956	1955	1956	1955
Crude: No. 1, No. 2, other	552	463	63	36
Milled: Group 3, spinning	22,821	26,569	2,601	3,162
Group 4, shingle	168,386	158,842	17,506	20,338
Group 5, paper	91,422	93,227	10,583	10,303
Group 6, stucco	141,219	145,496	13,004	13,890
Group 7, refuse	358,881	385,107	40,636	44,096
Group 8, sand	20,130	23,421	2,450	1,951
Total all grades	803,393	833,125	86,843	93,776
Total Canada	842,507	867,497	90,920	97,656

Canadian Asbestos Exports

(Short tons)

	9 months		September	
	1956	1955	1956	1955
Crude	420	415	122	52
Milled fibers	271,079	256,484	30,841	34,213
Waste, refuse, shorts	368,748	465,550	49,629	52,759
Total	640,247	722,449	80,592	87,024

Prepared in the mineral statistics section, industry and merchandising division, Dominion of Canada Bureau of Statistics, Ottawa.

Canadian Shipments And U. S. Gross Product

(12-month period, short tons—Quebec, Ontario, B. C.)

	1956 estimated	1955	1954	1948	1938
Crudes	800	724	725	977	2,911
Spinning, shingle, paper	378,000	395,820	326,653	241,953	163,097
Shorts, etc	622,000	667,982	596,738	473,839	123,785
Total all grades shipped	1,000,000	1,063,802	924,116	716,769	289,793
Produced	1,030,000	1,064,010	936,807	—	—
Value (shipped)	$100,000,000	$96,191,317	$86,409,212	$42,231,475	$12,890,195
Av. fiber price per ton	$100.00	$90.40	$93.50	$58.90	$44.40

	1956 estimated	1955	1954	1948	1938
U. S. gross product (billions)	$412	$385	$360	$225	$90
1938 = 100					
U. S. product	458	428	400	250	100
Spinning, shingle, paper	232	210+	200	150−	100
Shorts, etc	500−	540+	480+	380+	100

In the United States, production of Canadian-type chrysotile from Vermont continues to be the most important and constant at about 45,000 tons a year. Arizona low-iron fiber production is relatively small in terms of tonnage output but is important because of the special characteristics of the fiber. Total U. S. production for 1956 is estimated about 50,000 tons.

Italy is producing about 3,000 tons of chrysotile monthly, mainly from Belangero and Corsica. Australia is a small producer of blue and chrysotile, the output estimated during the past year at something less than 5,000 tons for the former, and less than 1,000 tons for the latter. Cyprus production remained normal despite the troubled conditions in that country.

So, in conclusion, 1956 ended with asbestos of all grades and types in ample supply, with inventories at relatively high levels and with a sense of wonder—in the mind of this writer at least—as to the ability of users to absorb the 40% increase in Canadian production alone which will be available to the world market within the next couple of years•

Fluorspar

Robert B. McDougal
U. S. Bureau of Mines

CONSUMPTION of fluorspar in 1956 rose above the record set in 1953 (587,000 short tons). Demand, which had declined in 1954, totaled about 570,000 short tons in 1955 and attained a new high in 1956 due to industrial expansion. Demand was met through increased domestic production and imports. Strong competition existed between the domestic producers and importers, and the level of domestic production was sustained in part by Government stockpile purchases.

Prices, which had declined to very low levels in recent years, improved slightly in 1956. Trade journal quotations for both metallurgical grade and acid grade increased somewhat between January and November.

In January, the U. S. Tariff Commission released the findings of the Commissioners on their investigation as to the effect of fluorspar imports on the domestic acid-grade fluorspar industry. A split decision was rendered: three of the six Commissioners had found a threat of serious injury and recommended that the 1951 tariff concessions be withdrawn, but the other three disagreed. In March, the President accepted the findings of those Commissioners that held that the domestic industry was not presently experiencing serious injury, that it was not faced with a threat of serious injury and that escape clause relief was not warranted.

Public Law 733, enacted in July after several bills were introduced in Congress, provided in part for the purchase of 250,000 short tons of newly mined domestic acid-grade fluorspar at $53.00 per short dry ton during the next two and a half years. Under provisions of the law the Department of the Interior was authorized to make purchase contracts. On July 31 Interior delegated this authority to GSA. Regulations were set up by GSA governing the purchase of the acid-grade spar. Legislation to purchase domestic acid-grade spar for the strategic stockpile program was passed to provide temporary assistance to the fluorspar producers.

Domestic fluorspar producers filed a petition with ODM for a hearing in June to seek relief under Section 7 of the Reciprocal Trade Agreements Act of 1955, claiming that imports posed a threat to the national security. Following an industry requested postponement and delay in calling the hearing, the producers cancelled the request in November.

Purchase of metallurgical-grade fluorspar for the National Stockpile was confined to purchase from domestic sources. ODM announced plans in July for a premium purchase program for stockpiling metallurgical-grade fluorspar.

A committee was convened by the Materials Advisory Board in September to consider several technical problems dealing with the use of fluorspar in industry.

Production of domestic acid-grade fluorspar was produced at approximately the same rate as in 1955. Imports exceeded domestic output in 1956 by an estimated 75%. Hydrofluoric acid plant consumption may have reached a new high of 290,000 tons and exceeded the tonnage of fluorspar used in the steel industry. In 1956, the chemical industry accounted for approximately 70% of consumption at hydrofluoric acid plants, contrasted with 65% in 1955. The remaining 30% was used in the manufacture of hydrofluoric acid to produce synthetic cryolite or aluminum fluoride for the aluminum reduction industry.

Ceramic-grade fluorspar production of domestic origin declined slightly from the previous year's output. Consumption was about equal to that in recent years and imports increased slightly. Competition has increased in recent years with imported acid-grade fluorspar sold for ceramic purposes.

Metallurgical-grade fluorspar from domestic sources increased to about 138,000 tons, about 62% over 1955. Imports of metallurgical grade increased over that for 1955 and exceeded domestic production by about 85%. Consumption of metallurgical grade may have approached 300,000 tons with steel plants accounting for approximately 263,000 tons. Consumption of fluorspar per short ton of basic open-hearth steel declined from an average of 5.9 lb per ton in 1953 to 4.9 lb in 1954 and 1955, then rose to an estimated 5.0 lb per ton for the first nine months of 1956. Consumption of metallurgical spar was materially affected by the steel strike in July, reducing by about 24,000 tons the amount used.

Illinois continued to be the leading producing state supplying about 70% of the total domestic output of finished fluorspar. Minerva Oil Co., Ozark-Mahoning and Alcoa, the major producers, operated throughout the year.

Production in Kentucky increased slightly over that of 1955, but was below the 1953 rate when Colorado supplanted Kentucky as the second largest producing state. Completion of a new mine shaft by Pennsylvania Salt Manufacturing Co. provided additional fluorspar capacity for its expanding fluorine chemistry program. Production in Colorado declined from the previous year. Nearly all tonnage reported from Colorado was acid-grade material.

Montana, Nevada and Utah production, mostly metallurgical-grade spar, increased over that for 1955. No production was reported from New Mexico, where General Chemical Division of Allied Chemical & Dye Corp.,

the state's last major producer, had closed its flotation mill in late 1955. Interest in fluorspar in Arizona and New Mexico was increasing.

The **domestic industry** was seriously concerned over competition with imports from foreign sources but it held an optimistic view of the consumption outlook. Consumption of acid-grade fluorspar was expected to grow if plans announced for expansion in the aluminum industry are fulfilled. An increase in the use of acid-grade spar in other chemical fields is also expected.

Ceramic-grade fluorspar market appeared to be firm, having maintained a fairly stable rate in recent years.

Demand for metallurgical spar was rising in accordance as the demand for steel continued to rise. Stocks at the consumers' plants currently appear to have stabilized, although in recent years they have fluctuated with market conditions.

U. S. Geological Survey released in November a report made for the Office of Minerals Mobilization on the fluorspar reserves of the U. S. This new reserve study estimates the total at about 22.5-million short tons containing more than 35% calcium fluoride or its combined equivalent value of fluorspar and metallic sulphides. These reserves could support mine production for 30 years at the 1951 to 1955 rate of about 750,000 short tons annual crude production•

Fluorspar Statistics

(Short tons)

	1956 estimated	1955
U. S. production:*		
Acid grade	165,000	168,200
Ceramic grade	22,000	25,800
Metallurgical grade	138,000	85,500
Total	325,000	279,500
Imports:*		
Containing more than 97% CaF_2	289,000	214,100
Containing not more than 97% CaF_2	257,000	155,300
Total	546,000	369,400
U. S. consumption:**		
Hydrofluoric acid	289,000	248,200
Steel	263,000	251,200
Glass and enamel	35,000	38,500
Other	31,000	32,300
Total	618,000	570,200

*Includes Government purchases
**Excludes Government purchases

Barite

Reginald Rowand
Baroid Division, National Lead Co.

AGAIN IN 1956, production of barite increased to meet the growing industrial demand. Estimated world production in 1955 was 2.6-million tons; an increase of 18% over 1954. Domestic production totaled 1,118,000 tons in 1955; an increase of 18% over 1954. Both world and domestic markets should show an increase in 1956 due primarily to the increasing demand from the oil well drilling mud industry.

In 1955, 1,142,000 tons were used as a weighting material in oil well drilling mud. Because wells are being drilled deeper, and more wells are being drilled, the barite requirement for the oil drilling industry should show an appreciable increase in 1956. Approximately 90% of barite used in drilling muds goes to Louisiana and Texas Gulf Coast.

Barite has many industrial uses other than as a weighting material for drilling muds. The remainder of the 1955 shipments were used in the following manner: 27,000 tons in paints, 29,000 tons in glass, 25,000 tons in rubber and 168,000 tons in chemical, aggregate and other miscellaneous uses.

Barite Statistics

(Thousands of tons)

	1956 estimated	1955
World production	2,800	2,600
U. S. production	1,150	1,118
U. S. imports	385*	360
U. S. industrial uses:		
Drilling mud	—	1,142
Paint	—	27
Glass	—	29
Rubber	—	25
Chemical, etc.	—	168

* First 9 months only.

Major barite shipments by states according to probable rank in 1955 were: Arkansas, Missouri, Nevada, Georgia, Tennessee, Montana and California.

Arkansas producers shipped 463,000 tons of barite in 1955. Shipments should show a small increase in 1956. Arkansas ore produced occurs as approximtaely 50% $BaSo_4$ and is mined by both open pit and underground methods. The ore must be finely ground for flotation recovery, and is used mostly in the oil well industry.

Missouri barite producers shipped 364,000 tons in 1955. Shipments should show a small increase in 1956. Missouri barite is mined by open pit from low-grade residual deposits and concentrated by washing and jigging. This barite is used in both oil well drilling mud and the chemical industry.

Nevada shipments increased from 100,000 tons in 1954 to 114,000 tons in 1955. Production has continued to climb in 1956 and should reach approximately 118,000 tons, which will be utilized mostly in the drilling industry.

Tennessee, South Carolina and Georgia 1955 output of 130,000 tons was an increase of 48% over the previous year. The increasing production trend in this area should continue through 1956 due mainly to the increasing demand from the Gulf Coast drilling industry.

Other states shipped a total of 41,000 tons in 1955 with the larger portion going to the drilling industry. These states should show a small increase in 1956.

Imports during the first nine months of 1956, to the U. S., reached an estimated 385,000 tons, a substantial increase over the entire 1955 imports

(360,000 tons). Imports from countries, according to rank by USBM, are: Canada, Mexico, Italy, Peru, Yugoslavia, Greece, Brazil and Sweden. This imported barite is processed mostly by Gulf Coast grinding plants. Small portion goes to Eastern plants.

Outlook. Increasing demands from the drilling industry give a bright picture to the future marketing of barite products. Facilities of many of the present operations will probably require expansion. Prospecting and developing new deposits will continue. Known deposits that were previously uneconomical will be restudied in the light of the increased demand. Foreign sources will be utilized to even greater extent. Strong competition in obtaining commercial deposits will continue in the foreseeable future•

Potash

Nelson C. White
International Minerals & Chemical Corp.

PRODUCTION in the U. S. in 1956 was at a rate of 3.6-million tons of products, based on preliminary data from the American Potash Institute and from individual companies. These contained 2.1-million tons of K_2O equivalent. Estimated production is slightly higher than for the year 1955.

During the first nine months of 1956, the most recent period for which data are available, total deliveries by domestic producers and importers were at an annual rate of 3,856,500 tons of product, containing 2,267,000 tons of K_2O. This is an increase of 3% over 1955, the smallest percentage increase for several years. During this period agricultural deliveries declined slightly; this was offset by a 13% increase in deliveries to the chemical industry and a 75% increase in exports.

Domestic producers shipped at an annual rate of 2,044,000 tons of K_2O during 1956, based on the first nine months. This represents an increase of 2.3%. Excess of production over shipments is concurrent with a projected leveling-off of domestic potash demand, increased inventories, and sharper competition throughout the industry.

Import data for the first five months of 1956 indicate an annual rate of 223,000 tons of K_2O, an increase of almost 10% over 1955. Potash imports are expected to increase because of greater excess of supply over demand in world markets, and because of recent U. S. rail freight rate increases which enhance the competitive delivered price advantage for imported material at East Coast ports.

Principal foreign countries which export potash to the U. S. are France, West Germany, East Germany and Spain.

Agriculture is the primary market for potassium-bearing materials and accounts for 93% to 95% of non-export sales on a K_2O basis. Of the total potash material used in agriculture, about 91% is in the form of muriate, and 9% is in the form of sulphate of potash and sulphate of potash-magnesia.

U. S. Potash Production*

(Short tons)

	Marketable potash salts	Approximate K_2O equivalent
1948....	2,138,493	1,139,881
1949....	2,056,609	1,118,395
1950....	2,242,647	1,287,724
1951....	2,474,870	1,420,323
1952....	2,866,462	1,665,113
1953....	3,226,429	1,911,891
1954....	3,322,395	1,948,721
1955....	3,505,505	2,064,808
1956**..	3,600,000	2,100,000

* Source: USBM 1948 to 1953
** Estimated

Sales to the chemical industry include both muriate and sulphate and account for 5% to 7% of non-export sales of potash.

Agricultural potash prices remained unchanged during 1956, continuing at essentially the same level since 1941.

U. S. production capacity continues to expand at a rapid pace. At present there are seven producing companies; five of these, located near Carlsbad, N. M., account for 90% of total domestic output. The remainder is supplied by one company in California and another in Utah. Two more producers are in prospect at Carlsbad, one to begin production and the second to begin construction during 1957.

Development of Canadian potash resources continued during 1956. All Carlsbad producers, and several from foreign countries, are reported to be exploring the Canadian fields. Potash Company of America completed ground freezing operations, made progress in sinking a shaft, and let an engineering-construction contract for surface plant facilities.

United States Potash Co. became a division of a new company, United States Borax & Chemical Corp., formed by merger with Pacific Coast Borax Co. USP neared completion of a $3-million expansion to increase capacity by 20%. Construction began on a 6-mile ore-haul road between shaft No. 3 and the original shaft. Ore will be transported in 50-ton diesel trucks and will be processed at the present mill at No. 1 shaft prior to moving to the refinery.

Potash Company of America completed construction of continuous miners of their own design, placed in service seven miles of belt conveyor, increased surface production facilities for chemical-grade muriate of potash, and constructed a 100,000-ton storage warehouse.

International Minerals & Chemical Corp. increased hoisting capacity, modernized and increased the capacity of its potassium sulphate plant, and completed a new office building at a cost of more than $250,000.

Duval Sulphur & Potash Co. extended its main line conveyor haulage system and installed additional feeder belts from new panel areas. Intensive plant tests were begun on new equipment for production of granular product from fines.

Southwest Potash Corp., a subsidiary of American Metal Co., Ltd., concluded a major expansion program designed to increase capacity of its mine and mill by one-third. Cost was estimated at $2.5-million. Changes included elimination of wet grinding of feed and addition of new classification, wet screening, and filtering capacity and instrumentation.

American Potash & Chemical Corp., which extracts potash from salt brines at Trona, Calif., increased capacity for producing granular muriate of potash by 50%, and plans a further 50% increase to be completed by April 1957. Company completed a new 7,500-ton storage silo and new bulk and bag loading facilities during 1956.

Bonneville, Ltd., producing potash from sub-surface brines of old Lake

Bonneville in northwestern Utah, completed a new dry storage building and spur track with scales. A new granulating plant began in late 1956.

National Potash Co., a joint venture of Freeport Sulphur Co. and Pittsburgh Consolidation Coal Co., started hiring for its new plant which is scheduled to begin production this month. Company's mine and refinery cost an estimated $18-million, and is the first in the Carlsbad basin to be located in Lea County.

Farm Chemical Resources Development Corp., completed plans for a $15-million plant near Carlsbad. Shaft-sinking was scheduled to begin early in 1957 and to be completed by December. Expected capacity is 1,000 tpd of finished product. Start of operations is set for late 1958•

Vermiculite

William S. Steele
American Vermiculite Corp.

DOMESTIC PRODUCTION for 1956 was at about the same level as 1955's USBM total of 195,538 tons, of which some 5,000 tons was produced by several small, independent mines, and the remainder by the Zonolite Co. Zonolite production was divided between its mines at Libby, Mont. and South Carolina, with slightly over one-third of the tonnage produced in South Carolina. Company showed a reduction in sales volume for the six-month period ending Sept. 30, 1956, of 7.2%, but it is expected that this reduction will be offset by the normal heavier volume during the last quarter of the year.

Importation of South African ore, controlled by the American Vermiculite Corp., continued to increase, due largely to the establishment of new exfoliating plants. Reports from both companies include Canadian shipments. American Vermiculite reports a wide, sectional variation from its projected tonnages due chiefly to the decline in home building in certain areas, while other sections of the country were enjoying substantial increases in the use of vermiculite plaster aggregate. Totals from both domestic and import sources are estimated at approximately 225,000 tons in 1956.

Price of crude vermiculite ore from all sources remained fairly constant throughout the year with domestic vermiculite ore ranging from $9.50 to $15 per ton (f.o.b. mine). The price of South African crude vermiculite increased in both the U. S. Gulf and Pacific Coast areas, and remained the same to Atlantic and St. Lawrence River ports. The cost of ore (f.o.b. South Africa) was unchanged; the increase arising from stiffened ocean freight rates. South African prices ranged from $27 to $37 per short ton (c.i.f. U. S. ports).

Dealer prices on exfoliated vermiculite increased in some areas because of higher beneficiating costs, while in other parts of the country they were unchanged because of competitive pressures. In general, dealer prices in truck-load quantities ranged from 95c to $1.50 per 4-cu ft bag, depending upon locality, grade and specifications.

Research activities by the Vermiculite Association, Inc., Vermiculite Institute and the individual expanding plants continued throughout the year with particular emphasis on the development of new types of acoustical products in both rigid and plaster form.

A national agreement between OP & CMIA, and the CPIA removing trade union restrictions from the use of plastering machines will have a decided influence on the use of vermiculite aggregate in the future, both for conventional plastering and for the fireproofing of steel floors, spandrels and other structural uses which have previously been covered by other trades.

An increase in the use of home insulation is expected throughout the South because of the almost universal use of home air-conditioning in both new and old construction.

The addition of suction-control admixtures in plaster aggregate has permitted the vermiculite industry to recapture much of the volume previously awarded to competitive types.

Use of vermiculite in home insulation, concrete and plaster aggregate, high temperature coatings, vermiculaponics, precast and molded articles, refractories, underground pipe insulation, as well as a carrier for pesticides and fungicide, were the principal outlets for vermiculite in 1956.

New discoveries of vermiculite continued to be reported during 1956 largely from Mexico, South America and the British Federation in Africa, but no commercial mining development has been started.

Outlook for 1957, among domestic producers, is for a normal increase in the use of vermiculite in its general field with new uses adding substantial tonnage to this volume. American Vermiculite Corp. reports that it expects a steady increase in its importations during the year 1957, due largely to the establishment of several contemplated new exfoliating plants•

Perlite

L. M. Otis
U. S. Bureau of Mines

AS IN 1955, New Mexico was the largest producer of crude and in 1956 furnished 44% of the total. Colorado and Nevada mined most of the remainder with some output from Arizona, California and Utah.

Uses. According to the Perlite Institute, 74% of all expanded perlite sold in 1956 was used by the plastering industry and about 50% of all plaster applied in construction work contained expanded perlite. They estimate that 12% went into concrete aggregate, 5% into oil well muds and oil well concrete, 5% into filter aids, and 4% into miscellaneous uses.

Producers. There were 13 companies mining crude perlite in 1956.

Perlite Statistics

(Short tons)

Crude perlite	1956 estimated	1955*
Sold by miners to expanders	214,000	198,446
Value, total	$1,918,000	$1,778,894
Average per ton	$8.96	$8.96
Used by miners	98,000	87,711
Value, total	$588,000	$502,738
Average per ton	$6.00	$5.73
Total crude sold or used	312,000	286,157
Value, total	$2,506,000	$2,281,632
Average per ton	$8.03	$7.97
Expanded perlite		
Sold or used	270,000	246,343
Value, total	$13,700,000	$12,585,297
Average per ton	$50.74	$51.09

* Based on USBM canvass

Eighty-four expanding plants located in 30 states were operated by 72 companies.

Metals Exploration Corp. of New York is reported to have acquired leases on perlite deposits in Pershing County, Nev., and plans to produce crude perlite. Kaiser Gypsum Co., Inc., has built perlite-expanding plants at Long Beach and at Antioch, Calif. The latter will expand perlite for Kaiser's wallboard product. U. S. Gypsum Co. built four new expanding plants during 1956; located at Stony Point, N. Y., Philadelphia, Pa., Boston, Mass., and Shoals, Ind. National Gypsum Co. opened a new expanding plant in New York City and another in National City, Mich., to be used principally to supply plaster. Federal Cement Tile Co. has erected a new plant at Hammond, Ind., for the expanding of perlite and the manufacture of panels for construction purposes.

Several ownership changes were reported: Richlite Perlite Co. of Omaha, Neb., was bought by Western Mineral Products Co. The plant of Federal Cement Tile Co. of St. Louis, Mo., has been purchased by the J. J. Brouk Co. Zonolite Co. has bought the Perlite Products Co. of Oklahoma City, Okla.

Outlook. Optimistic predictions from the trade for 1957 are based on expected increases in the following:

(1) Insulation and fireproofing in public and private buildings. Almost 90% of expanded perlite sales go into new construction.

(2) Lightweight aggregate in building plasters, concrete, gypsum wallboard and other insulation paneling and pipe insulation.

(3) In horticultural applications, as a plant rooting medium for nurseries, a soil conditioner for home gardens and as a carrier for fertilizers, insecticides and herbicides.

(4) Miscellaneous uses such as loose fill insulation, paint filler and filtration medium.

The Perlite Institute estimates the over-all increase in expanded perlite sales for 1957 at 12% •

Phosphate

H. F. Dengler
International Minerals & Chemical Corp.

INDICATIONS ARE that production in the U. S. during 1956 reached a record high; it is likely that in excess of 14-million long tons have been mined, against the 1954 high of 13.8-million tons. The Florida field will have produced about 10.8-million tons; the Western fields about 2-million tons and Tennessee 1.4-million tons when all 1956 figures are in.

The Florida tonnage increased considerably over 1955 (8.7-million tons) when a long strike hampered production. Depleted inventories were increased by 600,000 tons, while domestic shipments increased slightly to about 7.8-million tons and exports jumped to an estimated 2.4-million tons. Emphasis in the Tennessee area is more and more on producing a low grade feed for phosphorus furnaces. Some 300,000 tons of Western production was again shipped to Canada.

With total world production of phosphate rock at the 30-million ton mark, U. S. share is close to 50%.

Florida producers report no outstanding developments, but note a number of technological improvements:

American Cyanamid Co. operated at a normal annual rate without major expansion. Saddle Creek mine will be exhausted at the end of 1956 and construction is coming along well at the new Orange Park Mine, northeast of Lakeland.

Construction is well advanced on a 200,000-ton per year triple superphosphate plant at Brewster. Operations at both locations are expected to begin in mid-1957.

Coronet Phosphate Co., a Division of Smith-Douglass Co., Inc., put a plant on stream for producing potassium silico fluoride. Fluorine, formerly a waste product from the company's phosphate defluorination plant, is the key raw material. Plant is suitable for the production of artificial cryolite, sodium silico-fluoride, and other similar fluorides.

International Minerals & Chemical Corp. introduced a number of minor improvements in equipment and technology leading to increased efficiency and productivity.

The Atlantic Coastline Railroad built tracks into the Noralyn Mine and sufficient sidings to double the shipping capacity of this production center which formerly was served only by S.A.L. Railroad.

At the Bonnie phosphate chemical plant the production of sulphuric acid will be doubled, assuring a greater output of dicalcium phosphate and triple superphosphate, the main products of this plant.

Swift & Co. have a new Bucyrus-Erie 500-W walking dragline, 14-yd capacity, on order. They are installing conveyors over the dry rock storage bins to increase capacity. Minor work was done on remote controlling pumps on matrix lines. Pumps of more modern design are being installed and a large Le Tourneau earthmover has been acquired for faster dam construction.

Virginia-Carolina Chemical Corp. have nearly doubled production capacity of the Phosmico Plant. They have installed a special conveying,

U.S. Phosphate Statistics

(Thousands of long tons)

Mining district	1956 estimated: From 1955 inventory	Production	Shipments	Inventory	1955: From 1954 inventory	Production	Shipments	Inventory
Florida	1,491	10,800	10,200	2,091	2,309	8,747	9,565	1,491
Western field	1,085	2,000	2,200	885	358 596	2,052	1,921	1,085
Tennessee	230	1,400	1,400	230	463	1,466	1,699	230
Total U. S.	2,806	14,200	13,800	3,206	3,726	12,265	13,185	2,806
Imports			100				118	
			13,900				13,303	
Exports			2,700				2,183	
Apparent U. S. consumption			11,200				11,103	

storage and loading system at Nichols which has added to the flexibility of the Preparation Department operations. Capacity of the sulphuric acid plant has been increased by some 40% and the storage facilities for concentrated superphosphate have been enlarged by about 10,000 tons.

Kaiser Aluminum & Chemical Co. have taken an interest in the utilization of waste material from the manufacture of triple superphosphate and are constructing a pilot plant at Nichols.

Western Phosphate Field. Phosphate was produced in Montana, Idaho, Wyoming and Utah with Idaho having the largest tonnage and Montana next in line. Of the 2-million tons mined in 1956, about 65% went into electric furnaces and about 35% into fertilizers. The furnace rock contains about 25% P_2O_5 whereas the fertilizer material contains about 31%.

In Montana the following companies are active: Montana Phosphate Products Co., a subsidiary of Consolidated Mining & Smelting Co., operated throughout the year at their mine site near Garrison. Their entire output was shipped to the parent company to Trail and Kimberley, B. C.

J. R. Simplot Co. opened up and began production at their new mine in the Centennial Mountains. The open pit mine's substantial production was shipped to Northwest Nitro Chemical Ltd.'s new ammonium sulphate-phosphate plant at Medicine Hat, Alta., Canada.

In Idaho, Westvaco Mineral Products Division, of Food Machinery & Chemical Corp., received phosphate for their electric furnace plant near Pocatello from J. R. Simplot Co.'s Gay Mine and also did some mining of their own.

J. R. Simplot produced ore not only for the Westvaco operation but also for their own fertilizer operations at Don, near Pocatello, where triple, single superphosphate, and mixed fertilizers are produced.

Anaconda Co. halted underground mining at the Conda Mine near Soda Springs and went entirely into surface mining. Milled concentrates are shipped to the parent company in Anaconda, Mont. for processing into various types of fertilizers.

In Utah, the only operation in Utah was that of San Francisco Chemical Co. with its two underground operations in the northern end of the Crawford Mountains near Randolph.

In Wyoming, San Francisco Chemical operates the open-pit Leefe Mine near Sage Junction. Company has operated a dry attrition and separation plant to upgrade the phosphate. In addition, plans have been announced for a new hydro-metallurgical concentration plant, a process developed by research at the Colorado School of Mines Research Foundation which represents an entirely new approach to upgrade western phosphate.

In the Tennessee Field there were no significant developments except that International Minerals & Chemical Corp. completed installation of a large phosphate rock washer at its Godwin plant site which was purchased last year from TVA.

Victor Chemical Works announced intention to build a new phosphorus furnace at Mt. Pleasant to double production capacity.

Monsanto Chemical has finished the construction of new facilities for nodulizing phosphate materials for furnace feed.

Shea Chemical Corp. has constructed and put into operation a second large phosphorus furnace.

TVA* purchased a second tract of land during the year in the hard rock phosphate district of Citrus and Marion Counties, Florida.

*Information supplied by Dr. J. H. Walthall, director, Division of Chemical Development, Tennessee Valley Authority, Wilson Dam, Ala.

Small-scale tests were continued on the problem of improving methods of beneficiating hard rock phosphate.

Engineering work was carried to an advanced stage on a demonstration plant for the production of fertilizer from Florida leached zone ore and equipment is being obtained for the plant which will be located at Wilson Dam, Ala. Process involves decomposition of the ore with a nitric-sulphuric acid mixture.

Mining of phosphate matrix was continued in the Knob Creek area of Maury County, Tenn. The matrix is blended with purchased Florida pebble at Wilson Dam to make electric phosphorus furnace charge.

A water-scrubbing system was installed for removing fluorine from gases exhausted from the phosphate rock nodulizing kilns at Wilson Dam.

Research was continued on the production of "superphosphoric" acid, concentrated liquid fertilizers, superphosphate for immediate ammoniation, ammonium phosphate-nitrate, potassium phosphates and other fertilizers. Research also concentrated on finding ways to utilize the fluorine-bearing calcium silicate solution from Wilson Dam.

World phosphate picture. It is expected that during 1956 a total of over 30-million tons of phosphate rock has been shipped in the world. Next to the U. S. with 14.2-million tons ranks North Africa with a total of 9-million tons. Russia is supposed to have continued and increased its output on the Kola Peninsula, in western Russia, and in the Uzbek Republic to some 4.5-million tons. The phosphate islands in the Pacific Ocean (Ocean, Nauru, Christmas and Makatea) together will have produced and shipped a total of 2.8-million tons. Other smaller production around the globe brings up the total figure to well over 30-million tons•

Feldspar

Brooke L. Gunsallus
U. S. Bureau of Mines

PRODUCTION, based on the first nine months of 1956, was up about 10% over 1955. Crude production and ground production are estimated to have increased at about the same rate.

Activity among the producers during the year included the following: Feldspar Corp., Monticello, Ga., completed the first full year of operation of the only plant in the U. S. designed to produce high-potash feldspar by froth flotation from pegmatites. International Minerals & Chemical Corp. placed in operation in May 1956, a new nepheline syenite plant at Blue Mountain, Ottawa, Canada, with a potential annual capacity of about 100,000 short tons of saleable product; Spar-Mica, Ltd., of Montreal, Canada, was organized to develop and operate a large feldspar mining and milling project at Baie Johan Beetz, Quebec. Lawson American Feldspar Corp. was organized to process feldspar from Alaskite rock near Spruce Pine, N. C.; Bell Minerals Co. increased its mining facilities in Maine and installed new milling equipment to handle the additional tonnage. Del Monte Properties Co., Pacific Grove, Calif., installed adtional capacity to meet demand.

Decline in consumption in 1955 was more than recovered in 1956. The increase can be attributed for the most part to the very high level of building activity. The floor and wall tile, sanitary ware, and window glass industries all had exceptionally good sales for 1956. Flotation of feldspathic ores continued to increase, accounting for about 45% of all marketable feldspar in 1956, compared with 40% in 1955, and 35% in 1954. Part of this increase was attributed to operation of the Flotation Corp. plant at full capacity.

For the first time feldspar will be shipped by boat from Canada to the Eastern Seaboard of the U. S. Shipments will begin in mid-summer of 1957 when the new plant of the Spar-Mica Corp. and their new shipping dock in Quebec Province will be placed in operation. Potential annual plant capacity is said to be about 100,000 short tons 20-mesh saleable feldspar concentrate.

The Quebec plant will produce high-potash feldspar concentrate by a dry method covered by U. S. Patent 2,765,075, issued Oct. 2, 1956. No reagents or water are required. Steps include crushing in various stages, and electromagnetic and electro-static treatment to remove iron-bearing minerals, mica and free silica.

Dry-processed concentrate (20-mesh) will be shipped by boat to Camden, N. J., for trans-shipment directly to the glass trade or after further processing, to the sanitary ware, enameling and other ceramic industries. Ships, with a capacity of 10,000 short tons or more can be accommodated at the company's dock at Camden, N. J.

Nepheline syenite imports (ground) have increased progressively since 1944, with an increase in 1956 over 1955 of 4%. In 1955, imports increased 21% over 1954. Imports in 1956 amounted to about 120,000 short tons. Increased production in the glass industry, especially the glass-container branch accounted for most of the increase•

Sulphur

Langbourne M. Williams
Freeport Sulphur Co.

THE YEAR 1956 marked the third consecutive year in which U. S. production and consumption of sulphur attained new highs. The year also saw a continuation of the trend in foreign markets towards brimstone as a source of sulphur and continued activity in this country, Mexico and Canada to increase still further the supply of sulphur rfom various sources.

On the basis of preliminary data, it is estimated that sulphur production from all sources in the U. S. reached 7,875,000 long tons in 1956, up almost 12% over the previous year. Frasch process mines, located in Louisiana and Texas, alone accounted for 6,450,000 tons of brimstone, an increase of more than 12%.

Of the remainder of the supply, the greatest gain was made in recovered elemental sulphur, the primary source of which is sour natural gas. Native sulphur produced from surface deposits remained at about the same level, while sulphur in other forms obtained from pyrites and industrial gases gained somewhat as shown in the table above.

U. S. Sulphur Production

(Thousands of long tons)

	1956	1955
Frasch sulphur.....	6,450	5,750
Other elemental		
Recovered.....	500	425
Other native.....	50	50
Sulphur in pyrites...	425	400
Sulphur in gases....	450	425
	7,875	7,050

There were 13 Frasch process mines operating until late in the year when Freeport closed its small Nash property in Texas. Texas Gulf Sulphur Co. continued as the major producer, followed by Freeport, Jefferson Lake Sulphur Co., Duval Sulphur and Potash Co., and Standard Sulphur Co.

Consumption of sulphur in all forms is estimated, on the basis of preliminary data, to have risen from 5,650,000 tons to almost 5.9-million tons. About 350,000 tons of this represented imported sulphur. Incoming shipments in the form of pyrites remained at 150,000 tons, the same as in 1955, while imports of Frasch sulphur from Mexico made up the remainder.

Despite published predictions that their business in the foreign markets would decline during the year, the U.S. Frasch sulphur producers exported near-record quantities. It is estimated that 1.6-million tons were sent abroad in 1956, the same amount as in 1955 and only 50,000 tons below the 1954 high.

Export prices were reduced in February from $31.00 per long ton f.o.b. Gulf ports to $28.00 by Freeport and similar reductions were made later by other U. S. producers. No changes were posted during the year in the domestic price, which continued at $26.50 per long ton f.o.b. mine.

Two new Frasch process mines were under development in 1956 and plans were announced to mine a third new deposit. Those being developed are the Lake Pelto property of Freeport and the Fannett dome of Texas Gulf. The

former is located in the shallow waters of the Louisiana tidelands about 60 miles southwest of New Orleans.

The third deposit, known as Grand Isle—Block 18, lies off the coast of Louisiana beneath 45 ft of water six miles from the nearest land. The deposit, which is considered to be one of the most important sulphur discoveries of recent years, was discovered by Humble Oil and Refining Co. Upon approval by the Department of the Interior of the assignment of leases, Freeport will install and operate productive facilities. The Grand Isle project will be the first completely offshore sulphur mining operation ever undertaken.

Nine new sources of sulphur, other than Frasch process mines, came on stream in the U. S. during the year and productive capacity of six existing facilities was expanded. The total new annual productive capacity of these projects is estimated at about 300,000 tons.

The Frasch process mines of Mexico—the only ones outside the U. S.—produced an estimated 750,000 tons in 1956, which compares with output of 516,000 in 1955 and 86,000 in 1954, their first year of operation. Total shipments by the Mexican companies amounted to an estimated 525,000 tons, or about twice those of the previous year.

One new Frasch process plant was being completed late in the year by Texas Gulf at its Nopalapa dome, which is in the same general area of the Isthmus of Tehuantepec as the existing mines. The company built an entire mining plant and related facilities on two barges and towed them from Texas to the site on the Coachapa River.

Plans to construct a fifth new mine on this Isthmus were announced in January 1957 by Central Minera, S. A., a subsidiary of Texas International Sulphur Co.

New U. S. Sulphur Projects—1956

(Capacity in long tons)

	Annual capacity	Source
New facilities:		
Aurora Gasoline Co., Detroit, Mich.	10,500	refinery gases
Great Northern Oil Co., St. Paul, Minn.	17,500	refinery gases
Leonard Refining Co., Alma, Mich.	3,500	refinery gases
Montana Sulphur & Chemical Co., Billings, Mont.	14,000	refinery gases
Tidewater Oil Co., Delaware City, Del.	113,750	refinery gases
J. L. Parker, Levelland, Tex.	7,000	natural gas
Signal Oil & Gas Co., Neiber Dome, Wyo.	10,500	natural gas
Stanolind Oil & Gas Co., Odessa, Tex.	5,250	natural gas
Phillips Chemical Co., Andrews County, Tex.	21,000	natural gas
Total	203,000	

	Annual capacity increase	Source
Expanded facilities:		
Freeport Sulphur Co., Westville, N. J.	5,250	refinery gases
Hancock Chemical Co., Wilmington, Cal.	42,000	refinery gases
Hancock Chemical Co., Long Beach, Cal.	10,500	refinery gases
Sinclair Refining Co., Marcus Hook, Pa.	10,500	refinery gases
Union Oil Co. of Cal., Wilmington, Cal.	10,500	refinery gases
Union Oil Co. of Cal., Santa Maria, Cal.	15,750	refinery gases
Total	94,500	

In Canada a number of projects were completed or under way to tap reserves of sulphur which are primarily in the form of sulphide ores and natural gases with relatively high sulphur content.

In Western Canada, where new pipe lines are being constructed for the distribution of natural gas, British American Oil Co. completed a sulphur recovery plant near Pincher Creek, Alberta, with a designed capacity in excess of 78,000 tons annually, and Imperial Oil Ltd. completed a small plant at the Redwater Field. Still under construction is Jefferson Lake Sulphur Co.'s 100,000-tons per year capacity plant near Fort St. John, B. C., and plans were announced recently by Westcoast Transmission Co., Ltd., to construct a 175,000-ton a year capacity plant in the Savanna Creek area of Alberta.

In Eastern Canada the first plant to recover sulphur from oil refinery gases is being built in Montreal by Laurentide Chemical & Sulphur Co. It is scheduled to be in operation by the middle of 1957 and to have a capacity of about 35,000 tons per year.

Noranda Mines, Ltd., is building Canada's largest sulphuric acid plant at Cutler, Ontario. This plant will supply acid to the uranium mills of the Blind River area and will use pyrites from Noranda's own mines in Quebec. Lorado Uranium Mines, Ltd., is building an acid plant, also using pyrites, in the Beaverlodge uranium area.

Another announced project is that of Canadian Industries, Ltd., which plans to build a $3-million sulphuric acid plant at Copper Cliff, Ont. It will convert waste gases from International Nickel Co.'s smelter at a capacity rate of over 100,000 tons of acid annually•

Gypsum

Leonard P. Larson
U. S. Bureau of Mines

SPURRED ON by a high level of building activity, the gypsum industry continued to expand its mining and manufacturing facilities in 1956.

The decline in new home building in 1956 was greater than anticipated. A major factor in the decline was a shortage of funds for long-term low down payment mortgages at low interest rates. Housing starts during the first eight months were lower than the corresponding period of the previous year and the value of new homes being built was lower than in 1955. This capacity in the face of the decline in home building. Estimated total of domestic crude gypsum production during 1956 is nearly 10.8-million short tons, about 2% more than the output in 1955. The figures for the first six months of 1956 showed an impressive gain over the comparable 1955 figures, 5,436,839 short tons, as against 4,922,249 tons. However, based on the preliminary reports for the second half of the year, it appears that this rate of increase was not maintained. Output for the first three-fourths of the year showed a 3% gain over the same period of 1955.

Several large producers expanded

Lack of deposits in some sections of the country and economic reasons prompted a considerable tonnage of imported crude gypsum. Markets in large centers of population, especially on the eastern seaboard, can be supplied from deposits located in the Maritime Provinces of Canada which have the advantages of low mining costs, cheap ocean transportation to point of use, good quality and adequate tonnage. Most 1956 imports to fabricating plants in New England and other Atlantic Coast States, were from Nova Scotia. Substantial tonnages were imported from San Marcos Island in Mexico's Gulf of California for use in California and Washington. Imports of crude gypsum, which reached a low of 6% of the domestic supply during World War II, when many ore-carrying ships were requisitioned by various governments for transportation of military cargoes, has increased to 28% in recent years. In the last few years an apparent balance between the domestic and the imported crude was reached at about 72 and 28% respectively. For example, domestic production totaled 10,573,363 short tons in 1955 and imports 4,064,494 short tons. Available figures for the first three quarters of 1956 show a domestic production of 8,055.432 short tons of crude and 3,315,479 short tons of imports as compared to the same period of 1955 when 7,793,280 short tons of domestic crude were produced and imports totalled 2,754,178 short tons.

Several new plants were placed in operation by gypsum companies during the year: National Gypsum's new multi-million dollar paper mill at Anniston, Ala. which will manufacture wallboard covering from waste paper; expansion and modernization of National Gypsum's rock wool acoustical tile plant at Alexandria, Ind.; the same company's gypsum products plant at Westwego, La., and their new processing plant in Burlington Township, N. J.; Arizona Gypsum Corp.'s gypsum plant, Winkleman, Ariz.; a new agricultural gypsum plant of Power Gypsum and Manufacturing Corp., Lander, Wyo.; Kaiser Gypsum Co.'s gypsum products plant at Antioch, Calif., and a board and plaster plant at Long Beach, Calif.; Pabco Products, Inc. plant at Newark, Calif., and this company's new roofing plant Wilmington, Calif.; and Gypsum Products' new plant at Florence, Colo., for making wallboard lath and sheathing.

Outlook in the industry is for further growth. During 1956 several companies announced plans for construction of gypsum products plants. National Gypsum Co. plans to construct a $6-million wallboard plant at Lorain, Ohio. Company is also getting ready to develop its gypsum deposits located in northern Michigan near Lake Huron.

Celotex Gypsum Corp. plans to construct a new minerals fiber acoustical tile plant at Pittston, Pa., a gypsum products plant at Fort Dodge, Iowa, and a fiberboard plant at L'Anse, Mich. Flintkote Co. of East Rutherford, N. J. will start construction soon on a gypsum materials plant at Sweetwater, Tex. U. S. Gypsum announced authorization of a major expansion of facilities at the firm's Philadelphia location•

Mica

Milford L. Skow
U. S. Bureau of Mines

CONTINUED GROWTH of the electronic and electrical industries and the more rigid specifications for materials in the advancing technology have kept demand for sheet mica at a high level. Except for a slowly increasing use of mica paper in place of built-up mica made from splittings, strategic sheet mica has been displaced very little by substitutes.

Synthetic mica is not yet a substitute for natural block and film mica, but research has been intensified on producing single sheets and on reconstituting from the flake a sheet suitable for electronic uses.

Consumption of sheet mica in 1956 was essentially the same as in 1955. The continued high level of production of electronic and electrical equipment sustained the demand for block and film mica, about 60% of which went into electronic uses. Electrical insulation used about the same quantity of muscovite splittings as in 1955 and a slightly reduced quantity of phlogopite splittings. Insulation made by delaminating and reconstituting natural scrap mica continued to make inroads on applications formerly requiring insulation made from splittings. Total output of the two producers of reconstituted mica was about 30% greater than in 1955.

Preliminary reports indicated sales of about 108,000 short tons of ground mica, slightly more than in 1955. Close to 85% of the total was dry-ground mica and the remainder, about 15%, was wet-ground.

International Minerals & Chemical Corp. began operating its plant at Greeneville, Tenn., to produce ground mica from the silt behind TVA's Nolichucky Dam. About Nov. 1, Petaca Mining Corp. completed extensive alterations intended to bring the output of dry-ground mica from its grinding plant near Santa Fe, N. M., up to 60 tpd. The company shut down its wet-grinding operations.

A new use for ground natural mica was being exploited by Spruce Pine Mica Co., Spruce Pine, N. C., and Farnam Manufacturing Co., Inc., Asheville, N. C., who were hot-pressing phosphate-bonded dry-ground mica into sheets for subsequent fabrication into electrical insulation.

Imports of block and film mica were greater in 1956 than in 1955 while imports of splittings decreased. About 10% of all the muscovite block imported was Good Stained or better quality and about 60% Stained. Nearly all the imported muscovite film was equivalent to Good Stained or better block. India and Brazil continued to supply most of the muscovite sheet mica, and Madagascar furnished virtually all the phlogopite splittings.

Domestic production of muscovite ruby and nonruby block, film and hand-cobbed mica for sale to GSA continued at a high level. From mid-1952 to the end of 1956 the depots had accepted the equivalent of approximately 10,000 short tons of hand-cobbed mica (90 lb of full-trimmed mica equivalent to 1 short ton of hand-cobbed mica). ODM directed in June that the domestic mica purchasing program, originally slated to expire on June 30, 1957, continue in effect until June 30, 1962 or until total purchases are equivalent to 25,000 short tons of hand-cobbed mica, whichever occurs first. In May, revisions by GSA in the price schedule for the purchasing program increased prices offered for certain sizes and qualities of full-trimmed mica and increased charges by the Government for processing hand-cobbed mica on which payment was for actual yield of full-trimmed mica.

Mica in the U. S

(Pounds)

	1956 estimated	1955
IMPORTS:		
Block:		
India	**2,094,500**	1,814,894
Brazil	**2,060,000**	1,774,241
Other	**130,000**	106,591
Total	**4,284,500**	3,695,726
Film:		
India	**225,000**	208,374
Other	**500**	130
Total	**225,500**	208,504
Splittings:		
Muscovite	**7,500,000**	8,771,294
Phlogopite	**675,000**	821,371
Total	**8,175,000**	9,592,665

	1956 estimated	1955
CONSUMPTION:		
Muscovite Block and Film:		
Good Stained or better quality	**180,000**	187,169
Stained quality	**1,920,000**	1,960,012
Lower than Stained quality	**1,900,000**	1,933,230
Total	**4,000,000**	4,080,411
Splittings:		
Muscovite	**8,000,000**	8,204,210
Phlogopite	**650,000**	793,464
Total	**8,650,000**	8,997,674

During the first 10 months of 1956 DMEA furnished financial assistance in exploration for strategic mica on 66 active projects, 33 of which were new contracts executed during the period. The 248 contracts executed since the start of the program in 1951 have resulted in 58 certificates of discovery.

Although synthetic mica is not yet a substitute for strategic grades and qualities of block and film natural mica, synthetic mica, because it withstands higher temperatures than natural mica, has become a commercially valuable material in flake form. Electronic Mechanics, Inc., of Clifton, N. J., began producing synthetic mica flake which, like that of Synthetic Mica Corp. of Caldwell, N. J., now in its second year of production, was principally for use in glass-bonded mica products. Both companies have research programs on product improvement, additional end uses, and growth of large synthetic crystals.

On the 5-year program certified by ODM for development and evaluation of substitutes for strategic natural mica, GSA signed contracts in August with the U. S. Bureau of Mines for expansion of its synthetic mica research and, in November, with Frankford Arsenal for exploratory work on reconstitution of synthetic mica flake. A number of contracts with private industry on reconstitution and bonding of synthetic mica flake were being negotiated by GSA and were expected to be executed shortly•

Platinum

(Continued from P 107)

stantial increases in imports of platinum and palladium came from USSR.

The major market for platinum was the petroleum refining industry where the metal is used as a catalyst in the new reforming process for the production of high-octane gasoline. Platinum consumption for jewelry and decorative purposes continued to decline.

World output of platinum-group metals for 1956 is estimated as follows: Union of South Africa 390,000 troy oz; Canada 385,000; Soviet Union 100,000; Colombia 28,000; U. S. 24,000; total world production 927,000 troy oz. This total comprises about 590,000 troy oz of platinum; 310,000 palladium; 27,000 iridium, osmium, rhodium and ruthenium.

Domestic consumption of platinum in the first 9 months of 1956 was 300,760 oz, of which about 77% was used in the chemical industry; 11% electrical; 2% dental and medical; 9% jewelry and decorative and 1% miscellaneous. The quoted price range of platinum per fine troy oz was $117 to $97 in the first half of the year and $103 to $110 thereafter in 1956.

Platinum-Group Statistics

(Thousands of troy oz)

	9 months 1956	9 months 1955
Platinum-group:		
Imports	**777.0**	779.7
Domestic refined	**101.2**	73.4
Domestic consumption	**625.9**	616.4
Platinum:		
Domestic sales and exports	**318.3**	348.6
Imports and domestic refined	**384.4**	425.6
Palladium:		
Domestic sales and exports	**319.8**	264.4
Imports and domestic refined	**464.3**	407.7
Iridium, Osmium, Rhodium and Ruthenium:		
Domestic sales and exports	**23.1**	23.5
Imports and domestic refined	**29.4**	20.0

Palladium sales to consuming industries for the first half of the year aggregated 305,598 fine troy oz distributed as follows: Chemical 8%; electrical 78%; dental and medical 6%; jewelry and decorative 5% and miscellaneous 3%. The price remained unchanged at $23 to $24 per troy oz through the year.

Consumption of iridium, osmium, rhodium and ruthenium used principally in the chemical industry was 19,540 troy oz for the first 9 months as measured by sales. Prices quoted per troy oz for the four metals were unchanged at $100 to $110, $80 to $100, $118 to $125, and $45 to $55, respectively.

Outlook for platinum-group metals for 1957 is for slightly higher world production, adequate supply, and slightly lower domestic consumption due to decreased demand for platinum catalyst in petroleum refining as the rate of completion of new production facilities slows•

Technology

James W. Franklin
Associate Editor
Engineering & Mining Journal

"Ore dressing's top events in 1956 were wet cyclones; new equipment, techniques and reagents; high-pressure hydrometallurgy; and instrumentation. Solvent extraction, hydrometallurgy and halogenation will make further gains in 1957."

A. W. Schlechten
Professor of Metallurgical Engineering
Missouri School of Mines and Metallurgy

"Metallurgical advances in uranium plants, in separating minerals formerly believed inseparable, have highlighted progress in the past year. Smelting advances in zinc and iron ore show potential promise."

Lloyd E. Antonides
Associate Editor
Engineering & Mining Journal

"Equipment that applies smaller forces more continuously is proving its economy. On the horizon, research in rock mechanics gives promise of improvements in drilling and blasting as well as ground support."

Metallurgy

A. W. Schlechten
Missouri School of Mines

"LIQUID-LIQUID EXTRACTION" is a term that keeps popping up these days especially when people talk about recovery of uranium and some of the other new and unusual metals. The rather simple procedure brings an impure aqueous leach solution containing a variety of metals into contact with an organic solvent which will selectively extract the desired metal. In a second operation, the organic solvent is stripped by contact with another aqueous solution to yield a highly purified and concentrated aqueous solution of the desired metal.

Refineries have used the process for some time for treatment of U_3O_8 concentrates from the uranium mills. The concentrates are digested in nitric acid to form an aqueous solution of uranyl nitrate. In a liquid-liquid extraction unit, this solution is intimately mixed with an organic solvent such as diethyl ether which selectively removes the uranium. Uranium is then re-extracted from the organic solvent into a highly purified aqueous solution.

Now the same general procedure is being used for the extraction of uranium from the original leach slurries obtained in the treatment of uranium ore as an alternative to chemical precipitation or extraction with ion exchange resins.

In leaching uranium ores which do not settle or filter well, it is difficult to obtain a clear pregnant solution suitable for chemical precipitation. Furthermore, it is expensive to neutralize the excess acid in the leach solutions. One approach to this problem has been to avoid precipitation from the original leach solution and to extract the uranium from the pulp with an ion exchange resin.

Resins in the form of beads are held in stainless steel baskets, submerged in the leach pulp and moved in a countercurrent system. Subsequently the uranium is recovered in a concentrated solution from the resin. This procedure is comparable to the well known technique of using charcoal to extract gold from cyanide solutions.

Organic solvents rather than resins extract the values if liquid-liquid extraction is used. But the problem arises of what type of equipment can be used to bring a slurry or pulp into contact with the solvent.

Three types of devices have been described; one is a mixer settler in which the mixing and settling chambers are separate but connected at top and bottom.

In another type, the pump mixer, the mixing is achieved in a centrifugal pump which discharges into a settler.

The third variation is an internal mixer-settler in which the mixing occurs in a chamber within the settler.

In any of these the acid leach slurry is dispersed as droplets in a solvent such as DDPA (dodecyl phosphoric acid) and in two to four stages of extraction over 99% of the uranium can be recovered from the leach.

Subsequently the uranium is stripped from the organic phase with 10 M HCl, the HCl recovered by evaporation, and the resulting concentrated solution precipitated to give the uranium concentrate.

Uranium can also be recovered from phosphate rock which is being converted into triple super phosphate by liquid-liquid extraction from the H_3PO_4 solution which is formed in leaching the rock. The organic solvent used for this purpose is a 1 to 2% solution in kerosene of OPA (octyl orthophosphoric acid) or OPPA (octyl pyrophosphoric acid). The solvent is stripped with hydrofluoric acid and the uranium recovered as a fluoride salt.

Another successful application of liquid-liquid extraction has been in the separation of zirconium and hafnium, a task proverbial in its difficulty because of the chemical similarity of the two elements. Zirconium for use in reactors must be freed of the 2 to 3% hafnium which normally occurs with it.

Commercial grade zirconium chloride is put into aqueous solution as a zirconyl chloride; this feed which also contains hydrochloric acid and ammonium thiocyanate enters the top of the tall extraction columns and passes counter-current to a solvent of thiocyanic acid in hexone. The aqueous solution (raffinate) after extraction contains most of the zirconium and only traces of hafnium, while the organic liquid carries the hafnium. The aqueous solution is precipitated with di-ammonium phthalate or sulphuric acid to yield a hafnium-free zirconium compound, and the organic solvent is stripped to recover its hafnium and residual zirconium content.

One more example concerns the separation of two currently popular metals — tantalum and columbium. These two metals have been prepared commercially by fractional crystallization as fluorides, but it has been shown recently that they can be separated by various combinations of solvent-solvent extraction such as with tributyl phosphate solvent from a HF-HNO_3 or HF-H_2SO_4 leach:

There has been considerable interest in the separation of nickel and cobalt by solvent extraction. Several studies have been made which show satisfactory separations in chloride solutions using methyl-ethyl ketone as a solvent, and there are current studies which show good separations using TBP and other solvents which have been shown to be useful in uranium work. There is indication that the separation can be made in sulphate solution as well. As far as is known there has been no work on nickel-cobalt separation on a large scale, and it is likely that the economics are such that it will be a long time before anyone attempts pilot operation. Alternative methods can do a satisfactory job at lower cost, although possibly without such great selectivity.

Magnesium will be produced by Dominion Magnesium's ferrosilicon method in the 10,000-ton per year plant under construction by Alabama Metallurgical Corp. at Salem, Ala. Process reduces dolomite with ferrosilicon, rather than Dow's electrolytic Pidgeon process.

Choice of this method is tied in with expanding zirconium and titanium production. Both of these metals use magnesium reduction and ferrosilicon-produced magnesium is said to be superior for this job.

Molydbenum fabricating idea suggested by Universal Cyclops Steel Corp. may be key to fabricating this metal at high temperatures. Idea is that moly will be forged in inert gas atmosphere, where workers will be equipped with space-suits and two-way communication.

Cathode antimony is being refined to 99.95% purity by Sunshine Mining Co., Kellogg, Idaho, by removing copper, lead, arsenic and iron with an electric furace treatment at 590 deg F in presence of NaOH. Impurities are then removed by leaching melt in near-boiling water.

Gilsonite. American Gilsonite has started production of gasoline and coke from uintaite, an asphaltite having high resin and low sulphur content.

Smelting zinc ores in a blast furnace is one of those processes that seemed impossible for many years but has finally yielded to the ingenuity of the modern metallurgist. There is no difficulty in reducing zinc oxide with carbon monoxide in the lower part of a blast furnace, but at the prevailing temperatures the zinc is in the form of a vapor which promptly reoxidizes in the upper, cooler portions of the furnace.

Maier in the introduction to his famous thermodynamic study of zinc smelting tells of an elaborate attempt to run a zinc smelting furnace under pressure so as to produce the zinc in liquid form that could be tapped from the furnace. He stated that all such attempts were unsuccessful and he showed by calculations why they did not work.

Now the National Smelting Co. of England is said to be smelting zinc successfully in a blast furnace. No details have been published, but some information can be gleaned from patents issued to Stanley Robson, S. W. K. Morgan, S. E. Woods and others of that company.

In the first place, the furnace is different from a standard blast furnace in that preheated air is introduced both at the bottom through the tuyeres and at the top to permeate down through the charge. The zinc vapor and other gases are withdrawn near the center of the furnace. Aside from this variation, the operation is fairly orthodox in that preheated new charge, consisting of oxidized zinc compounds, coke and fluxes, is added at the top and molten slag is removed at the bottom.

The gases from the furnace are conducted to a condenser where as much as possible of the zinc vapor is condensed to liquid metal. A typical composition of the gases from the furnace is said to be: 5% Zn, 5% CO_2, 27% CO, and 63% N_2; and they will be at about 950 deg C; it can be seen that there would be a great tendency to reoxidize the zinc if a customary simple cooling method of condensation were used.

National Smelting Co. has patented methods of shock-cooling the gases before reoxidation can take place by bringing them into contact with molten lead which is at a relatively low temperature. Such contact can be made in counter-current columns, in spray chambers, or by violent agitation. The lead-zinc alloy is then cooled even further in a separate part of the system to freeze out most of the zinc and the lead can be returned to condense more vapor.

One interesting claim concerns a detail of introducing an oxygen-bearing gas into the blast furnace gases before they reach the condenser. This burns some CO and causes an increase in the CO_2 percentage. At first thought it would appear that more zinc would then be reoxidized, but the patent claims that the resulting rise in temperature actually reduces the amount of reoxidation of zinc before condensation.

Rumor has it that a substantial

Smelting and Refining Continues to Expand

FOLLOWING ALONG with our ever expanding world economy and rising standard of living, the smelting and refining industry continues to put the money on the line for new projects and expansion of old facilities.

Over $370-million in new projects has been announced for copper, aluminum and other metals. Some $70-million worth of plants is now under construction, and over $80-million is being spent on expansion.

These Projects Are in the Works . . .

COPPER

Stuart, Queensland, Australia. American Smelting & Refining Co. may build $5-million copper refinery

Sangi, Philippines. Atlas Consolidated Mining & Development Corp. is planning smelter to handle 10,000 tpm concentrate

URANIUM

U. S. Allied Chemical & Dye Corp. will build 5,000-ton green salt refinery for AEC. Site to be determined

FERROMANGANESE

Andhra, India. Gov't will build 30,000 annual ton ferroalloy production unit

COLUMBIUM-TANTALUM

Muskogee, Okla. Fansteel Metallurgical Corp. will build $6.5-million layout

TITANIUM

Natal, Union of South Africa. Explosives & Industries plans $5.6-million dioxide production unit

ZINC

Mexico. 135-tpd zinc smelter output planned. Will cost $30-million, but location is up in the air

Sabac, Serbia, Yugoslavia. Zorka combine will erect 6,000 ton per year electrolytic plant

MAGNESIUM

Montgomery, Ala. Alabama Metallurgical Corp. will set up $7-million pyrometallurgical plant to make 10,000 tons annually

ALUMINUM

Edea, Cameroons. Pechiney group has one in the works

Ohio River Valley. Olin Revere Metals Corp. announced a $231-million layout

Mirakud, Bihar, India. Indian Aluminium Co., Ltd., plans 10,000 annual ton output

India. Gov't will build two additional smelters

Evansville, Ind. Aluminum Co. of America will build $80-million, 150,000 ton per year smelter

While These Are Expanding . . .

COPPER

Paipote, Chile. Gov't will double smelter capacity to 260,000 ton charge yearly. Cost will be $2-million

Hayden, Ariz. Ray Mines Div., Kennecott Copper Corp. is spending $40-million to increase mine, mill and smelter capacity to 25,000 tpm concentrate

Butte, Mont. Anaconda Co. is spending $9-million on mill and smelter

Noranda, Que. Noranda Mines, Ltd., is expanding 50% to hit 350-million lb copper output

ZINC

Kellogg, Idaho. Bunker Hill Co. will reach 7,200-tpm output after $7-million program

URANIUM

Fernald, Ohio. National Lead Co. has about completed $20-million expansion begun in 1954

TITANIUM

Masillon, Ohio. Republic Steel Corp. hopes to produce 12-million lb per year after $8-million job

portion of the zinc production of the National Smelting Co. is now coming from blast furnace smelting. Engineers particularly interested in the physical and chemical conditions for the reduction of zinc will enjoy the treatise on the Gaseous Reduction of Zinc Oxide by Gotthard Bjorling published in Stockholm but written in English. Equilibrium conditions, thermodynamic calculations, rate studies and other valuable data are given.

High-intensity arc, boiling-refining of metals and recovering the valuable metal as either metal or halogen salt is being investigated with considerable interest. Ore or concentrate is baked with coal to produce an electrode to be fed through high-intensity furnace, where metals are boiled away from gangue and reduced. Metals can be separated from each other in vapor stage by both chemical and physical means. Vitro Corp. has just announced plans to pilot this method on manganese.

Steel Making Progress. Hydrogen-reduced iron is a step nearer being commercial. Method that hopes to bypass the blast furnace is past the semi-commercial stage at Hydrocarbon Research's Trenton, N. J., laboratory. In joint effort with Bethlehem Steel Co., this method was developed to reduce powdered iron ore to metal with high pressure hydrogen at 900 deg F.

Dorr-Oliver Inc., Stamford, Conn. has a process under development that reduces hematite to magnetite in Fluo-Solids reactor. And, company is reported to have a two-stage reduction process in the laboratory that takes hematite to magnetite to metal.

Revolution in steel-making may be on the way if Cyclosteel Process, developed by British Iron & Steel Research Association is successful. Ideal now being readied for pilot plant, would eliminate blast furnace, sintering, pelletizing, coking plants and make use of low-grade coal and fine iron ore.

Cyclosteel process feeds ground ore and coal into combustion chamber where oxide reduces to metal and slag, without fluxes being added. Melt spirals down the chamber to tap-out pot below. Cyclosteel takes its name from the cyclone effect produced in chamber by combustion of coal forced into furnace with iron ore and air.

Halogenation Gains Ground. At last year's Symposium on Extraction Metallurgy of Less Common Metals in London, uses of chlorine, fluorine and iodine were the major topics. Wolframite, vanadinite and chromite can be separated from ore with chlorine. So can uranium, thorium, columbium.

In U. S., Bureau of Mines developed low-temperature chlorination method to make titanium in two-step reaction

ALUMINUM

Wenatchie, Wash. Aluminum Co. of America is spending $2-million in step by step jump to 108,500 ton annual output

Construction Has Started Here . . .

COPPER

Sinoia, Southern Rhodesia. Messina (Tvl) Development Co. will spend $10.8-million on Mangula mine to produce 10,000 tons refined copper a year

ALUMINUM

Grevenbreich, West Germany. Aluminum smelter will have 12,000-ton output annually

The Dalles, Ore. Harvey Aluminum Co. is building $44-million refinery

ZINC

Cartagena, Spain. Celdram SA Mining Co. to smelt 150,000 tons a year ore

TITANIUM

Ashtabula, Ohio. National Distillers Products Corp. plans 5,000-ton sponge output a year

THORIUM

Chattanooga, Tenn. Heavy Minerals Co. (Crane Co., Vitro Corp. and Pechiney) is building $6-million refinery

COBALT

Garfield, Utah. Calera Mining Co. (Howe Sound) plans $750,000 refinery

IRON ORE

Houseville, Pa. United States Steel Corp. is spending $30-million to reach 15,000-tpd sintering rate

NICKEL

Chicoutimi, Que. Eastern Mining & Smelting Corp. wants 15-million lb per year output

PYRITE CHEMICALS

Salisbury, S. Africa. African Explosives & Chemical Industries will have $8.5-million refinery

And These Are Onstream . . .

COPPER

Serbia, Yugoslavia. Sevojno copper combine finished its 21,000 ton per year rolling mill

Gaspe, Que. Gaspe Copper Mines, Ltd., completed its $39-million mine, mill and smelter. 6,500 tpd

Quintero, Chile. Gov't smelter going

NICKEL

Riddle, Ore. Hanna Coal & Ore Corp. added last furnace to their 30-million lb ferronickel project

THORIUM

Curtis Bay, Md. Davison Chemical Div., W. R. Grace & Co. cut the ribbon on 25-tpd monazite refinery

VANADIUM

Otanmaki, Finland. Otanmaki Corp. is running 300-ton per year metal refinery

GILSONITE

Fruita, Colo. American Gilsonite Co. spent $16-million on this 600-tpd gasoline-from-gilsonite refinery

But Be on Lookout for Developments In These Areas . . .

ALUMINUM

Cape York, Queensland, Australia. Consolidated Zinc Corp. is considering aluminum smelter here

Moscow, Idaho. Anaconda Co. may be building in this area if aluminum-from-clay is ready and possible

San Balandran, Spain. Empresa Nacional de Aluminio has suggested to government plans for 15,000 ton output a year

New York State. Reynolds Metals Co. is considering possibility of smelter in this area

ZINC

Cape Breton Is., Nova Scotia. Minerals Exploration Corp. may build 150-tpd zinc metal refinery

on ilmenite-containing concentrate.

Bureau also developed titanium from scrap process that recovers 70% of the titanium, with re-refined metal of better quality than that produced by iodide method ($100 a lb). Process may lead to fuller use of scrap now accumulating in the industry.

Iodine is used in Australian patent to produce hafnium-free zirconium from zirconium carbide by forming tetraiodide, then the trihalide that is volatilized to produce high purity zirconium iodide.

Fluorine can be used to produce uranium, columbium, beryllium and hafnium-free zirconium, according to London symposium.

In U. S., Bureau of Mines has process that separates columbium from tantalum through hydrofluoric-hydrochloric acid leach, followed by solvent extraction with tantalum-selective methyl isobutyl ketone. Columbium remains in acid liquor.

Feed material production, the making of green salt (UF_4) from yellow cake, employs hydrofluoric acid. Basic process converts yellow cake to nitrate with nitric acid for solvent recovery of the nitrate and the reduction of nitrate and fluorination in presence of hydrogen yields green salt.

Zirconium. Rapidly growing interest in the peace-time uses of atomic energy have boosted the demand for zirconium metal, that one-time rarity which is now an essential material for reactor construction. The original sponge producing plant of the Bureau of Mines at Albany, Ore., which was shut down as one of the moves to get the Government out of business, has been reopened. It's being operated by the Wah Chang Corp. to supplement production of the only other zirconium plant, that of the Carborundum Co. at Akron, N. Y.

Early in 1956 the AEC let contracts to National Distillers, National Research and Carborundum Metals for new zirconium plants which will produce at a rate of well over 2-million lb per year.

As far as is known, the new plants will use either the established Kroll process or the comparable sodium reduction. This would indicate that despite all of the fevered research, there have been no radically new methods developed that seem commercially feasible.

A most elaborate report on the details of zirconium production and fabrication as developed at Albany can be found in USBM Bulletin 561 published during the past year. Some of the details of the zirconium-hafnium separation—formerly classified—and other approaches to zirconium production can be found in Vol. 8 of the Proceedings of the International Conference on the Peaceful Uses of Atomic Energy•

Ore Dressing

James W. Franklin
Associate Editor

WITH MILLS BECOMING more complex and expensive each day, metallurgists are directing their attention to newest equipment, techniques and reagents in the never ending search for a better way to supply the raw materials for our expanding world economy.

Foremost example of complex, high-temperature, high-pressure hydrometallurgy is Sherritt Gordon Mines Ltd.'s Ft. Saskatchewan nickel refinery, where pressure leaching has been so successful that Sherritt is expanding mining plans at Lynn Lake and contracting for custom concentrates to feed the refinery.

Newest example of high construction cost is Reserve Mining Co.'s $190-million project at Silver Bay, Minn. Their concentrator, the E. W. Davis Works, is 1300 ft long with twenty-four 3,000-ton ore bins feeding 12 identical grinding and concentrating circuits, each duplicating their Babbitt pilot plant. Reserve Mining just recently went onstream and will treat 10-million tons of ore a year to produce 3.7-million tons of pellets.

According to *EM&J*'s mining projects survey (see pages 134 and 130), the mining industry will spend over $800-million on a world-wide basis to build new mines, mills and smelters in 1957. In addition, some $200-million will be spent on plant expansion.

McGraw-Hill Publishing Co.'s Economics Department survey on 1957 capital investment plans shows that U. S. mining industry will spend 9% more in 1957 than it did in 1956, with this high spending rate to continue on through 1958.

What were the important developments in ore dressing 1956? We asked practicing mill men, the world over. Their answers show that they considered advances in wet cyclones, new equipment, techniques, reagents, ion exchange, hydrometallurgy and process instrumentation to be most important.

Tomorrow's interest may well focus on solvent extraction, high-temperature, high-pressure hydrometallurgy, the re-examination of old and almost forgotten processes, moving-bed techniques and the use of chlorine and anhydrous acids to leach complex ores and concentrates.

On the following pages, we present a survey of the events mill men consider to be important to the industry, along with steps they have taken to improve their own mills.

Fuller Use of the Wet Cyclone on Ore

"Roan Antelope replaced obsolete mechanical classifiers in final stages of our one-stage grinding, two-stage classification circuit. Capital cost is only 10% of mechanical units and over-all power consumption, maintenance and efficiency are about the same for both methods on bornite, chalcopyrite and chalcocite in argillaceous shale.

"We also use cyclones to scalp out relatively coarse material from concentrate prior to thickening ahead of filtration.

"At Roan, all tailing dams are built with 6-in. cyclones spaced along top of dam. Coarse material is used for dam building and fines are pumped to pond center. This has reduced labor requirements, increased building rate and produced a stable wall, resistant to scouring by heavy rains."— Mr. R. Goldick, concentrator superintendent, Roan Antelope Copper Mines Ltd., Luanshya, Northern Rhodesia.

Also in Africa, Union Miniere du Haut-Katanga uses cyclones to size middlings on malachite flotation circuit, but found that cyclones could not be used on ore itself, due to excessive wear, high horsepower demand and instability due to very nature of the ore.

"In Australia, cyclones replaced rake and bowl classifiers at Lake View & Star Ltd., Fimiston, and gave equally good sizing, with lower operating maintenance and costs. Another plus at Lake View is that cyclones make more operating space available and eliminate need for spiral scoops on secondary and tertiary grinding mills. Lake View treats auriferous pyrite, free gold and tellurides in quartz dolomite greenstone."—R. C. Buckett, assistant general manager.

In U. S.—Kennecott Copper Corp. replaced four conventional classifiers at Chino with one 20-in. cyclone and an 8-in. pump. This cut horsepower demand on the circuit from 120 to 60. At Manganese Inc., Henderson, Nev., eight 12-in. cyclones handle 1,200 tpd in sizing circuit, while other cyclones are used to thicken concentrate.

Another new cyclone is now available. Liquid-Solid Separations Ltd. has developed a unit that contains forty-eight 30-mm hydroclones than can handle up to 200 gpm at 40 psi on a 5 to 10 micron cut. And, Equipment Engineers, Inc. has produced a completely hydraulic apex valve that offers better control to the operator.

Better Equipment To Do a Better Job

Better equipment drew votes from M. A. Jorgensen, mill superintendent, Idarado Mining Co., Telluride, Colo. and many others, as top event in 1956. There is plenty of evidence to support this view. For example:

Impact crushing. According to *Z. Erzbergbau Mettalhuttenw*, an impactor that had replaced older secondary crushers and cut operating costs at Mechernick, Germany, has been removed in favor of a Symons No. 3. Reasons given are: great wear-rate and heavy maintenance. Impact operating cost was 1.06 DM, as against only 0.35 DM on the Symons No. 3. Also, tonnage crushed in the Symons was 11.5 tph as against 8.8 on the impactor.

On the other hand, Dr. Edgar Puffe, Mechernick, states that an impact unit, installed for fine crushing ability, along with a heavy media system and Humphrey spirals, cut milling costs over that of previous flotation method from 5.2DM to 3.7.

Aerofall mill. East Daggsfontein Mines Ltd., South Africa, installed a 17-ft-dia mill, cut operating cost 4.97 shillings per ton (over 10% reduction in over-all working cost to mine and mill). In addition, recovery of uranium went up from 79 to 88.5% and sulphuric acid use dropped by 35%.

Mill liners. Climax Molybdenum Co. found that one type of liner was best for normal mill operation, while another was more suited to excessive loads. According to Frank J. Windolph, *AIME Trans.*, August 1956, shiplap type is better than single wave at 78% critical speed, but don't reverse shiplap at this speed. Double wave type shows good wear rates, although it is more expensive. Reducing

mill speed to 66% critical speed will cut liner wear. Other points brought out were: thin liners are best for overloaded mills and spiral liners appear to offer good throughput by changing ball action.

Grinding balls of tungsten carbide are available for vibrating and gravity mills, according to Kennametal Inc. These balls show wear life in excess of 100 times that of ordinary balls.

Wet screens. Dutch State Mines' sieve-bend bar screen allows feed to flow down a curved bar-sieve at up to 200 m^3 per hour. Very few data have been released on this idea, but we note that several U. S. equipment makers are investigating.

Dry screening. Particle sizer that cuts in 15 to 40 micron range at up to 10 tph has been developed by Sharples Corp., Philadelphia, Pa. Device uses air vortex induced by dust collector-blower to size. Company is building 40-tph model.

Dry concentrator. Paul Flack, Flack & Co., Australia, has been developing a dry concentrator for heavy minerals (tin, tungsten and gold). He reports that results to date are encouraging. Device is a form of shaking table.

Wet concentrator. Tedman Separator is a wet classifier or concentrator, depending on use. It is a horizontal cylinder fitted with 11-turn internal spiral groove that has a water inlet on each turn and two conical exits. A 4-in.-dia model will size 2 tph.

Jigs. Two new jigs were introduced. One, by Bico Inc., operates dry, using sonic and supersonic vibrations to concentrate. The other, by Western Machinery Co., is a wet jig, with two separate sonic frequencies imposed on bed.

Flotation equipment. "Air control device placed on Fagergren machine results in improved selectivity and easier air control."—F. H. Sharp, assistant mill superintendent, Sunshine Mining Co., Kellogg, Idaho.

One new machine was patented and another new model was placed on the market. U. S. Patent No. 2,769,538 describes a machine that claims better and lower reagent consumption by forcing pulp and reagent through nozzle feed system. And, Denver Equipment Co. introduced the 72-in. monstrous Sub-A, that Jack Myers helped design.

Filters. "Lake View & Star replaced cotton filter cloth with nylon and got better cloth life, filtration rate and lower maintenance costs."—R. C. Buckett.

Denver Equipment Co. introduced a new size in disk filters—9-ft-dia, 105 sq ft of cloth per leaf, with up to 12 leaves possible. And, Dorr-Oliver Inc. showed a continuous pressure centrifuge that will filter 90 to 250 gpm at 100 psi and 300 deg F.

Eimco Corp. offers a combination traveling belt and drum filter that uses a stainless steel belt (much like a string filter) to pull cake away from the drum.

Drying equipment. Rotary drum and moving steel belt idea is also used in Jeffrey Mfg. Co.'s compact dryer that eliminates agglomeration.

According to Messina (Tvl) Development Co., FluoSolids roasting of copper-zinc ores ahead of leaching, improves both leaching stage and subsequent electrolytic deposition of the Cu and Zn.

Wet dust collector now being marketed by Joy Mfg. Co. is small, compact and offers low operating cost.

Synthetic flocculants drew votes from Charles Chapman, metallurgist, Virginia Carolina Chemical Corp., Nichols, Fla.; Edward S. Frohling, Edward D. Tierney, and several others. This reagent is being used to improve settling and filtering rates, clean up thickener overflow and increase plant capacity.

"Since flocculants first came out, we have had no more dirty thickener overflow in our two copper leaching plants and our plant capacity has been doubled. Reagent cost is about 7c a ton."—Fernando Benitez, consulting metallurgist, Santiago, Chile.

Better Reagents in Flotation and Leaching

Flotation reagents. "Lake View & Star is now using triethylbutane (TEB) to improve froth texture and cut frother costs. Gold ore responds with just as good cleaner concentrate as previous combination." — R. C. Buckett.

One fluorspar producer is reported to have replaced oleic acid with a low resin tall oil and Frother-65. Results—a 60% reduction in collector consumption to do the same work as the previous combination.

Hydrometallurgy. Cheap ammonia, acids and even chlorine gas have increased research and development into new and old techniques. Some companies are re-evaluating almost forgotten methods, such as Mineral Separations' salt roast for copper.

"In the use of ammonia, Sherritt Gordon Mines Ltd.'s process is now fully developed, producing high grade nickel at the rate of 20-million lb a year."—K. O. Cockburn, general superintendent, metals.

Further Extension of Ion Exchange

Ion exchange drew votes from H. R. Banks, metallurgical consultant, Ottawa, Canada, and John S. Anderson, Henderson, Nev.

Ion exchange, while useful in some rare earth separations, still finds uranium its best field. At present, 47 uranium mills use this method, either in columns or RIP. Cerro de Pasco reported an attempt to recover copper from mine water. Result—cost was too high with such a low copper content.

Resin-In-Pulp process costs are in the $5- to $6,000 per ton per day range on a 300-tpd project. Latest large RIP concentrator is Uranium Reduction Co.'s stainless-steel unit at Moab, Utah. Project was fully described in *E&MJ*, January 1957. Mill cost $8-million, will treat over 1,500 tpd.

Porous membranes made of ion exchange resins, such as were developed by Ionics Inc., will allow operators to make fresh water from saline in water-short areas. These plants, one of which is under construction on the Persian Gulf, can make drinking or process water at moderate cost.

Solvent extraction looks like the metallurgical tool of tomorrow, for uranium, rare earths and even copper and zinc. Climax Uranium Co., Grand Junction, Colo., and Kermac Nuclear Fuels Inc., Shiprock, N. M., report that 99.8% dissolved uranium recovery is possible with this method.

Vitro Corp. will convert Salt Lake City, Utah, ion exchange mill to solvent extraction. In a paper published by Dow Chemical Co., we find that if copper content is high enough, this process could recover metal at 8c a lb. Techniques are improving, new and better reagents are being found and operating costs are coming down.

(*Continued on page 136*)

Mines and Mills Continue to Keep

OVER $600-MILLION in mine and mill construction is in the works and expected to start in 1957. This tremendous growth follows on the heels of another $600-million worth of construction under way at this time.

Reserve Mining and San Manuel helped bring the dollar value of mills completed in 1956 to more than $300-million. And, over $150-million will be spent by the industry to expand existing workings.

Yet, with all this exciting growth, the best is yet to come. Watch areas below for new and big developments.

Following Projects Will Get Underway Shortly . . .

COPPER

Rapu-Rapu, Philippines. Hixbar Mining Co. 275 tpd
Mtuga Mine, N. Rhodesia. Magundi Copper M&M Ltd.
Temagami, Ont. Temagami Mining Co. 2,000 tpd
British Columbia. Cowichan Copper Ltd. 6,000 tpd
Atacama, Chile. Mining Bank, two 400-tpd mills
Mantos Blancos, Chile. Compania Mantos Blancos SA.
El Salvador, Chile. Andes Copper Co. (Anaconda Co.)
Ravensthorpe, W. Australia. Ravensthorpe Copper Mines
Siena, Nicaragua. Ventures Ltd. 600 tpd

IRON ORE

Bruce Lake, Ont. Iron Bay Mines Ltd. 500,000 tons yearly
Bristol, Que. Pickands, Mather & Co. 600,000 tons yearly

URANIUM

Riverton, Wyo. Lucky Mac Uranium Corp. 750 tpd
Mary Kathleen, Queensland, Australia. Rio Tinto Co.
Ford, Wash. Dawn Mining Co. (Newmont Mining) 400 tpd
Gunnison, Colo. Gunnison Mining Co. $2-million
Grants, N. M. Homestake New Mexico Partners

TITANIUM

Ceylon. Gov't will mine and mill beach sand

NICKEL

Moak Lake, Manitoba. International Nickel Co. will spend $175-million on mine, mill and smelter

GOLD

Beni State, Bolivia. South American Gold & Platinum
Van der Heeversrust, Orange Free State, S. Africa. Anglo Transvaal Cons. Investment Co.

TUNGSTEN

South Korea. Gov't. will build 80-tpd, $2-million mill

ALUMINA

Dakar, French West Africa. Bauxites de Midi (Aluminium Ltd.) 250,000 tons alumina annually

SULPHUR

Grand Isle, La. Freeport Sulphur Co. Frasch plant

LITHIUM

Herb Lake, Manitoba. Green Bay M&E Ltd.
Lalin, Spain. Lithium Corp. of America may build

OTHER NON-METALLICS

Black Lake, Que. Lake Asbestos of Quebec Ltd. (AS&R) is building 5,000-tpd mill, cost $7.7-million
La Borrequita, Mexico. U. S. Gypsum Co., 30,000 tpm
Neiveli, India. Gov't $147-million lignite project

These Are Under Construction . . .

COPPER

Zambales, Philippines. Mindanao Mother Lode. 4,000 tpd
Toquepala, Peru. Southern Peru Copper Corp. 80-million project to treat 30,000 tpd
Pima, Arizona. Pima Mining Co., 3,000 tpd
La Africana, Chile. Santiago Mining Co. (Anaconda Co.)
Hope, B. C. Canam Copper Ltd. 1,000 tpd
Kaskabowie, Ont. Coldstream Copper Mines Ltd. 1,000 tpd
Manitouwadge, Ont. Wilroy Mines Ltd. 1,000 tpd

IRON ORE

Hull, Que. Steel Co. of Canada (Jones & Laughlin and Pickands, Mather & Co.) 60,000 tons pellets yearly
Moose Mt., Ont. M. A. Hanna Co. 50,000 tons yearly output
Calumet, Minn. Jones & Laughlin Steel Corp. is building 200,000 ton a year flotation and gravity mill
Aurora, Minn. Erie Mining Co. $300-million taconite concentrator is half complete. 7.5-million tons per year

URANIUM

Elliot Lake, Ont. Cons. Denison Mines Ltd. 5,700 tpd
Elliot Lake, Ont. Northspan Uranium Mines Ltd. $40-million for mill or mills to treat 9,000 tpd
Bancroft, Ont. Faraday Uranium Mines Ltd. to 1,000 tpd
Mexican Hat, Utah. Texas Zinc 775 tpd
Bedrock, Idaho. Atomic Fuels Extraction Corp. 200 tpd
Rifle, Colo. Union Carbide Nuclear Co. 1,000 tpd
Crooks Gap, Wyo. Lost Creek Oil & Uranium Co. 400 tpd

TUNGSTEN

Currais Novos, Brazil. Wah Chang Corp.

GOLD

Union of South Africa. Winkelhaak GM

SILVER

Candelaria, Nev. Argentum Mining Co. 500 tpd

BORON

Boron, Calif. Borax Cons. Ltd., $18-million layout

LITHIUM

Cat Lake, Manitoba. Lithium Corp. of Canada

OTHER NON-METALLICS

Buckingham, Que. Eastern Asbestos Co. 200 tpd
Gramercy, La. Kaiser Industries. $70-million. Alumina
Quorn, S. Australia. S. A. Barytes Ltd. 10,000 tons yearly

And These Are Onstream . . .

COPPER

Chibuluma Mine, N. Rhodesia. Chibuluma Copper Mines Ltd. $17-million, 40,000 tpm ore
Chibougamau, Que. Chibougamau Explorers. 500 tpd
Tiger, Arizona. San Manuel Copper Corp. 35,000 tpd
Duparquet, Que. Beattie-Duquesne Mines. 500 tpd
Bagacay, Philippines. Elizalde & Co.

URANIUM

Elliot Lake, Ont. Algom Uranium Mines Ltd. Nordic mill, 3,000 tpd; and Quirke mill, 3,000 tpd
Moab, Utah. Uranium Reduction Co. $8-million, 1,500 tpd
Vaal Reef, S. Africa. Hartebeestfontein Gold Mining Co. 100,000 tpm feed rate
Bancroft, Ont. Bicroft Uranium Mines Ltd. 500 tpd

IRON ORE

Douglas, Minn. M. A. Hanna Co. heavy media plant

Pace With Expanding World Economy

Silver Bay, **Minn.** Reserve Mining Co. 3.7-million tons
Negaunee, **Mich.** Cleveland Cliffs Iron Co. 30,000 tpd
Copper Cliff, **Ont.** International Nickel Co. $19-million
Acari, **Peru.** Pan American Commodities S. A. $7-million

GOLD
Australia, Northern Hercules NL, 3,000 tpd
Orange **Free State, S. Africa.** Merriespruit Gold Mining Co. (Kennecott Copper Corp.) 75,000 tpm ore

LEAD
Chihauhua, **Mexico.** Canamex Mining Ltd. 100 tpd
East Tintic, **Utah.** Bear Creek Mining Co. $8-million
Castano Nueva, **Argentina.** National Lead Co. 6,000 tpm
Mestersvig, **Greenland.** 18,000 tons yearly. $4.1-million

LITHIUM
San Antonio, **Texas.** American Potash Corp. $6.6-million

OTHER NON-METALLICS
Battle Mt., **Nev.** Magnet Cove Barium Corp. 200 tpd
Salinas, **Mexico.** Compania de Azufre Veracruz SA. $4-million Frasch sulphur plant
Brewster, **Fla.** American Cyanamid Co. 200,000 tons annually—triple super phosphate plant
Haiti. Reynolds Haitian Mines Inc. 40,000 tons bauxite yearly

With Expansion Going on Here . . .

Inspiration, **Ariz.** Inspiration Cons. Copper Corp. $5-million to reach 16,000 tpd LPF
Brome Twp., **Que.** Quebec Copper Corp. to reach 1,000 tpd
Sombrerte, **Mexico.** Compania Minera San Martin. 1,000 tpm
Chuquicamata, **Chile.** Chile Exploration Co. (Anaconda Co.) $21-million to reach 45,000 tons refined copper yearly
El Teniente, **Chile.** Braden Copper Co. (Kennecott Copper Corp.) $1.9-million on flotation plant
Toledo, **Philippines.** Atlas Cons. Corp. to 10,000 tpm

IRON ORE
Steep Rock, **Ont.** Steep Rock Iron Mines Ltd. to reach 5.5-million tons per year, will spend $60-million
Michipicoten, **Ont.** Algoma Ore Properties Ltd. to reach 1.7-million tons per year
Sierre Leone, **Africa.** Sierre Leone Dev. Co. $42-million to hit 3.6-million tons annually

URANIUM
Beaverlodge, **Sask.** Gunnar Mines Ltd. to reach 1,650 tpd
Beaverlodge, **Sask.** Eldorado Mining & Ref. Co. to 2,000 tpd
Blind River, **Ont.** Pronto Uranium Mines Ltd. to 1,500 tpd
Salt Lake City, **Utah.** Vitro Corp. $1.2-million

TITANIUM
Tahawus, **N. Y.** National Lead Co. 25% expansion

LEAD
Leadville, **Colo.** Newmont Mining Co. and AS&R to 400 tpd

NICKEL
Sudbury, **Ont.** Nickel Rim Mines Ltd. to reach 1,000 tpd

MOLYBDENUM
Climax, **Colo.** Climax Molybdenum Co. to 3,500 tpd

PLATINUM
South **Africa.** Rustenburg Platinum Mines Ltd. $7-million

LITHIUM
Val d'Or, **Que.** Quebec Lithium Corp. to hit 1,800 tpd

OTHER NON-METALLICS
Bartow, **Fla.** International Minerals & Chemicals Corp. $4-million to reach 500,000 tons phosphate yearly
Asbestos, **Que.** Johns-Manville Co. $1-million

But Watch For Future Developments Here . . .

COPPER
Antamina, **Peru.** Cerro de Pasco, 70-million tons
Landa, **Peru.** Standard Ore & Alloys, 9-million tons
Rio Blanco, **Chile.** Cerro de Pasco, 28-million tons
Mantos Verde, **Chile.** Societe des Mines de Charriere
San Fernando, **Cuba.** Minas de Matahambre
Sudbury, **Ont. Cons.** Sudbury Basin Mines
Kenora, **Ont.** Maybrun Mines Ltd. 1,000 tpd
Iskut, **B. C.** Newmont Mining, Hudson Bay and others
Ft. Jameson, **N. Rhodesia.** Big strike made
Bwana Mkubwa, **N. Rhodesia.** Rhokana Corp. may reopen
Eire. Work in progress at Allihies, Shallee and others

IRON ORE
Franceville, **Belgian Congo.** Compagnie Miniere de l'Ogoue
M'Kambo, **Africa.** Bethlehem Steel Corp.
Southern **Rhodesia.** Messina (Tvl) Dev. Co. Ltd.
Swaziland. Havelock Asbestos area
Mt. Wright, **Que.** Jones & Laughlin Steel Corp.
Sault St. Marie, **Ont.** Frobisher Ltd.
Lethbridge, **Alberta.** West Canadian Collieries Ltd.
Steep Rock, **Ont.** Canadian Charleson Ltd.
Klukwan, **Alaska.** Columbia Iron & Steel
Surigao, **Philippines.** Large iron-nickel deposit here
Balabac, **Philippines.** Another large deposit of iron
Ashland County, **Wis.** Jones & Laughlin Steel Corp.
Birmingham, **Ala.** Republic Steel Corp. and National Lead
Nowa Nowa, **Victoria, Australia.** Many interested
Pas de Rio, **Colombia;** and Rosario de Lerma, Argentina
Dunderland Valley, **Norway**

URANIUM
Ambrosia Lake, **N. M.** More mills possible
Elliot Lake, **Ont.** Three more mills possible
Bancroft, **Ont.** Cavendish, Dyno and Greyhawk may build

ZINC
Minas Gerais, **Brazil.** Votorantim Co. 35% Zn
New Brunswick, **Canada.** Increasing exploration

NICKEL
Dutch New Guinea
Cuba. Another big one possible
North Rankin area, **N. W. T.**
Homonhon Is., **Philippines.** Elizalde & Co.

TIN
Durango, **Mexico.** Compania Minera Colorado

GOLD, SILVER AND PLATINUM
Kinross, **Transvaal.** Maybe seven new gold mines here
Virginia City, **Nev.** Comstock lode may be reopened
Northern **Argentina.** Large platinum placer found

MANGANESE
Franceville, **Belgium Congo.** World's second largest

BAUXITE
Hawaii Islands
Costa Rica. Alcoa, Kaiser and others interested
Nuria Highlands. **Venezuela.** Large deposit
Amapa, **Brazil.** Kaiser Industries
Sheveroy Hills, **Madras, India.** Big deposit found

POTASH
Saskatchewan. Large deposits, many companies bidding

Improved Techniques in the Mill

Stripa absolute gravity process, by J. Svensson, formerly with Stripa Mining Co., Stripa, Sweden, "is now being used at five Swedish and two Norwegian iron mines and one Turkish chrome property"—Göte Eriksson, general mill superintendent.

Process uses fine (plus 12 to plus 200 mesh) hematite-magnetite table concentrate as medium and no attempt is made to recover medium lost in float, since it amounts to 0.8 lb per ton ore. With this 65% Fe material and the Stripa separator, they are able to perform separation at 3.3 specific gravity. They report having made separations at 5.0 sp gr by substituting granulated iron for the table concentrate.

Separator is a long, narrow, shallow shaking-trough with water inlets in deck. Feed enters at rear end (60% solids) and leaves trough at forward end by sending float over a horizontal baffle and sink under it. The device will work without the feed water, but they prefer to use some water as a lubricant and to control pulp density.

It is interesting to note that Stripa system can stand up to 20% gangue in the medium without impairing results.

Magnetic and electrostatics. Roasting sand ahead of these steps will permit separation of mixtures hitherto considered inseparable, according to tests by U. S. Bureau of Mines. Apparently, heat changes surface on some minerals and these changes in electrical conductivity are irreversible.

Melbourne University research has developed an 8-stage electrostatic method that will recover 98% of scheelite in ore.

"Flotation practice at Gabbs Exploration Co., Gabbs, Nev., 100-tpd scheelite mill has been altered as follows: we take our rougher concentrate and give it a 4-stage deactivation in what has been our cleaner cells, then send it over a table. This produces high grade scheelite and table tails go back to conditioning"—W. M. Dougan, mill superintendent.

"Floatability of slimed manganese oxide ore at Henderson, Nev., is a function of power input in conditioning (emulsion flotation, where up to 200 lb of reagent per ton of ore are used), other variables being constant. At certain maximum power (35 kwh per ton here), which must be determined for each ore or blend, floatability reaches a constant maximum. However, amount of conditioning power applied to the easiest ore is far beyond that normally used for soap or sulphide flotation."—John S. Anderson, general superintendent, Manganese Inc.

"Improved flotation of sphalerite through use of ethyl xanthate and Aerfloat 211 and low temperatures has been achieved at Raible Soc. Mineraria del Predil, Cave del Predil (Udine), Italy. Ore is sphalerite, galena, pyrite, arsenopyrite and barite"—Dr. Ing. Italo Mancini, mill superintendent.

German reports state that 6 to 18 C amines will float KCl from NaCl and that keserite can be floated from halite with sulfonates and sulphuric acid alkyl esters. In laboratory work, D. W. and M. C. Fuerstenau demonstrated that flotation is a function of ionic size. If RNH_3 ion fits into crystal lattice of sylvite and not halite, then the sylvite will float. *AIME Trans.*

Flotation practice at Braden has being altered as follows. In crushing section, 10 Symons crushers have replaced eight, 30-year-old machines. In grinding section, four primary mills and two Dorr-Oliver classifiers have been installed. These changes resulted in Braden rising capacity to 34,000.

Additional changes to be made include complete replacement of eight banks of 950-tpd air cells with ten banks of 1300-tpd Fagergrens.

On another copper circuit, Union Miniere finds that regrinding middlings on the chalcocite-malachite circuit in Kolwezi leads to better selectivity and separation of the two concentrates. Ore is chalcocite-malachite in dolomite.

Union Miniere also has a complex cleaner circuit on Kipushi sulphide ore that results in a better grade zinc concentrate. Two sulphide concentrates are made here—copper and zinc.

W. R. Horst, Foote Mineral Co. and T. M. Morris, Missouri School of Mines, offered data showing that more attention should be paid to impeller speed, even to determining the proper speed for each cell in the bank. In Australia, Zinc Corp. added to this theory with results obtained from their modification of Denver No. 30 cells.

According to C. W. Thomas, chief metallurgist, Zinc Corp., in *Australian Institute of Mining & Metallurgy*, certain changes in design of these cells and reduction in impeller speed cut power demand to 43%, with prospects for better metallurgical results.

Better Instrumentation for Process Control

This was another favorite in the voting. And perhaps no mill illustrates instrumentation to the degree that Sherritt Gordon does. Others are turning more and more to process instrumentation as processing becomes more complex. For example:

According to C. H. G. Bushell and M. Malnarich, Consolidated Mining & Smelting Co. installed pH meter and xanthate recorder to develop fuller control at Sullivan. Tests showed that wide variations existed in reagent conditions and mill results.

A nonmetallic producer found that the grade was so profoundly influenced by pH, that they installed a pH meter and controlled acidity in each bank on both roughers and cleaners.

An iron ore producer has installed an Isotope Products' Gammagage in their heavy media plant. This unit measures and records pulp density within the meter, using a radioactive source outside the meter.

Another pulp density meter has been developed by Marcy Mill Div., Mine & Smelter Supply Co., but it does not use radioactivity. And, Minneapolis-Honeywell Regulator Co. also has introduced a density meter that uses a displacement receiver to measure and record. Unit is sensitive and uses no radioactive source.

One large lead-zinc producer reports that they installed a media recording and controlling device in their heavy media plant and a spectrograph for reagent control in their flotation circuit. Further refinement in control was obtained by setting up a pH meter and recorder.

At a large copper mill, Industrial Physics & Electronics Co.'s gram-sensitive conveyor scales have been installed along with Electronics' automatic lime titrator and addition-recorder instrument.

Messina (Tvl) Development Co. reports that electronic controls have been added to rod mill.

One new control aid is the solenoid-operated, quick-dump valve developed by Humphrey Products Inc. This valve opens and closes up to 30,000 times a minute, offers uniform flow control for gas and liquid.

For dry feeding, Eriez Mfg. Co.'s tiny vib-feeder will feed accurately in the grams to 500-lb range•

Mining Practice

Lloyd E. Antonides
Associate Editor

This article is based on replies to a questionnaire asking for comments on new or unusual practice or equipment, which was sent to over 300 mining officials around the world—to whom *E&MJ* expresses its thanks for the excellent response. We feel the entire industry also owes our informants a big thanks for being willing to share their experience. In addition to major articles, on a monthly basis *E&MJ* attempts to keep up with practice through our "Operating Ideas" department. We welcome any comments on mining practice at any time from any of our readers.

RESEARCH IS A KEYNOTE RUNNING through our survey. Practically every mine has at least one project. But as it should be for "earth" engineers and scientists, rock mechanics is "the object of our affection" judging from replies to our questionnaire and from volume of literature published last year.

Geomechanics is not a new interest but its application to breaking as well as support is worth noting. The design of products to do that work is related also. It is a topic to watch and study.

Surface Mining

In surface mining these are the big items this year:

Low cost fertilizer grade ammonium nitrate explosive is widely used for primary production blasting in all rocks—carbonaceous ingredient is simply petroleum oil poured into hole while loading.

Fast drilling roller-cone rotary bits with tungsten carbide buttons on cone face, have definitely extended rotary drilling to hard rock—costs are reasonable.

Skip hoisting is gaining advocates.

Stripping overburden with bucket-wheel excavators is reportedly adopted by Nchanga Consolidated Copper Co. in Northern Rhodesia. Last year we could only report applications to German coal stripping where their theoretical efficiency, coming from a more continuous application of smaller digging forces, is field proven. Truax-Traer Coal Co. uses 10,000 yd per shift unit at Fiatt, Ill. The story at Nchanga: two excavators; 86-ft benches, removing 50,000 cu yd per day of clay and soil; a high speed—800 fpm, twice normal—54-in. wide by 8,000 ft long belt conveyor. Some German units have belt speeds to 1,600 fpm for casting.

Wheeled scrapers are gaining popularity for removal of unconsolidated cover by many properties. As on any wheeled equipment, water inflation of driving wheels is used for added traction when needed.

Those that excavate with water—hydraulicing and dredging—repeat their claim to lowest costs. But water must be readily available. Dragline cranes and dragline-scrapers also are proving near the low cost end for those who try them.

For preliminary bench drilling and other smaller scale development on rough surface, the use of crawler mounted percussion air drills with integral or towed compressor has just about become standard. Kaiser Steel's use of G-D Airtracs at Eagle Mountain is an example. But small rotaries (for 2- to 6-in. holes) and "down-the-hole" percussion machines are starting to find advocates—the former in softer rock, the latter in harder. They too have been mounted on smaller crawler chassis.

A large southwest copper pit replaced percussion drill with small rotary drill and air compressor mounted on D-6 Cat tractor to establish new benches and for rail grade preparation; they say it is very good for high banks, holes up to 6-in. dia and up to 150 ft deep. Of course, skid and wheeled (wagon and self-propelled) units have not been eliminated in smoother terrain with few obstacles.

New development reported from an Arkansas bauxite property is a truck-mounted coring auger with saw-tooth bit, mechanical rotation and hydraulic feed. It has cut sampling errors from salting and faulty depth measurements and gives excellent recovery. It has also been used for some blasthole work.

Trucks and tractor-trailers, being easily routed to any destination over simple roadways, are very widely used all over for transportation in both solid and loose waste removal and other pit development. Kennecott's Chino pit and another large copper producer in the southwest as well as Anaconda in Montana, combine truck and rail—making use of dipper shovels for loading and a dock for dumping into rail cars.

Rather than doing their own stripping, many mines are finding economies in contracting for it. This is especially so for large strip ratios. And more so when large construction companies—which have plenty of specialized equipment for a fast job—do it.

Ratio of waste to ore is increasing in line with effort to keep mine a surface operation as long as possible and thus benefit from the considerably lower costs as compared to underground excavation. The largest we know—30 to 1—is at the Rattlesnake pit of Continental Uranium near La Sal, Utah. It has to be seen to be appreciated; an average of nearly 200 vertical feet of mudstones has been removed, leaving a slope close to 45 deg, to expose 4 to 5 ft of uranium ore. One explanation is that the erratic nature of ore makes open pitting a more complete extraction method. It also permits simple drifting into adjacent pockets.

In spite of accepting increased waste to ore ratios, a fair number of open cast mines are going deep enough to have underground schemes under consideration. Properties in colder regions, where weather is a tough enemy, are looking closest. Even a granite quarry in Massachusetts is looking. The large scale underground methods—heading and benching in large open stopes (as at Riverside Cement Co.'s Crestmore limestone mine in southern California), room-and-pillar continuous mechanized mining in thin bedded deposits (as in Carlsbad potash district and coal mines) and block-caving—are chopping costs down towards those in open pits.

Production has been broken into more specific phases below but a few

comments pertain to the overall picture.

There is a trend toward lower benches. Perhaps the increased mobility of equipment makes the increased safety aspects (lower muck pile and overhang) economically feasible. Some operators say shorter, smaller holes and closer spacing give better fragmentation but others disagree. Never-the-less, the trend is there, and one asbestos pit went as far as cutting 125-ft benches in half to 65-ft.

Glory holes should not be discounted. A multi-pit diatomite operation in California uses underground electric rail haulage from bottom of glory holes for handling 12,500 tons per one shift day. An interesting, highly efficient gold mine in Montana needs only 14 men for entire operation. All primary breaking of 2,000 tons per two shift day is done by blasting. Ore is dozed into raise to underground belt for conveying to cyanide plant.

Cold weather operations have a test ground at Gunnar Mines Ltd., northwest Saskatchewan, (6,500 tpd, pitchblende in granite and gneiss). N. A. Grant, assistant mine manager, reports all equipment is modified for arctic operation. Manufacturers have cooperated in design of new equipment. But lubricants and petroleum products are a problem in spite of the excellent cooperation of oil companies.

Air-flush drills with closely sited movable air compressors cut moisture-freeze. Shovel booms and other equipment parts have been satisfactorily refabricated of U. S. Steel's "T1" alloy steel and welded with AWS-8016 (2½% Ni) electrodes.

Batteries are troublesome so air starters are a must, especially on shovel engines. But gasoline engine starters on Cat units are alright. Lighting units operate 16 hr per day in winter. Downtime was excessive and costly for auxiliary gasoline-engine generator sets. So power take-off unit now makes use of shovel diesel engine. Exhaust heated body on dump trucks. cuts freeze-sticking. Plastic and rubber seals and hose are as brittle as glass. Leather is better for seals but still poor. For hose, a single wire braid hydraulic hose works best.

Stockpiling seems of interest to several companies. Some huge stackers and sub-surface tunnels for reclaiming have been installed at iron and taconite shipping points. But for stockpiling at pit itself, Three Kids Manganese Mine, Henderson, Nev., routes all 1,500 tons of muck to blend piles so combination of layers gives desired mill feed, according to Victor Howard, mine superintendent.

Breaking

Ripper attachments serve well in softer ground, breaking ahead of wheeled scrapers. Eagle-Picher's 150-tpd diatomite mine in Nevada uses a tractor ripper followed by loading with a 4-cu yd front-end Hough Pay-Loader into 25-cu yd end-dump semi-trailers.

Drilling primary blastholes with air-flush, roller-cone rotaries is apparently winning out in all large pits. As has been reported, it is fast, eliminates bit sharpening, sludge disposal and water supply; cuts maintenance and labor and gives more uniform size hole and readily available stemming. Probably only two situations continue to be hold-outs. One is the massive, homogeneous taconite or silicious iron ore of the iron ranges where jet-piercing is still the only economic solution. The second is in fractured harder rock on deeper holes where the down-the-hole percussion units are performing best with somewhat smaller holes.

Two preliminary remarks on rotaries are noteworthy. Air collectors on the original equipment have generally been discarded and a little water is fed to air stream which kills dust and makes cuttings—which are excellent stemming—form compact pile at collar. Speeds range from 2 to 6 times as fast as churn drills.

Richard W. Whitney, manager, M. A. Hanna Co. mines in Minnesota, gave a paper at AMC meeting in Los Angeles, in which he details the development of a tungsten carbide-button studded roller cone bit which has made air flush rotary drilling feasible in many taconite formations. Biggest problem was making bit larger in diameter to permit better hard surfacing and strengthening of components and sealing moving contact surfaces from dust.

Here are some comments:

Chile Exploration (112,000 tpd), Glenn S. Wyman, manager—Joy 60 BH rotaries newly purchased.

U. S. Steel, Minnesota mines—rotaries proving themselves and bit-life in hard ground being whipped.

Bagdad Copper (copper sulphides in quartz monzonite), E. L. Jones, chief engineer—rotaries cut costs.

Kennecott Ray Mines (copper sulfides in schist with diabase, 16,000 tpd)—rotaries replacing churns for 9-in. by 55-ft holes, 2 B-E 40 R's and one Portadrill.

Another large copper mining company (igneous porphyry)—testing rotaries to replace 12-in. churns at several pits.

Jet piercing continues at work on hard taconite. Satellite drilling, mentioned last year, is proving successful for cutting secondary work. Technique is to percussion drill small holes into any obvious blocks around primary hole and blast together. Chambering primary hole increases efficiency too.

Down-the-hole machines have been well accepted. Ingersoll-Rand's Depthmaster can now drill 4¾- to 7-in. holes. Reich Brothers are now offering an earlier announced Belgian design for smaller holes, about 4-in. Some claim they should be called rotary-percussion since there is a constant rotation and pressure from separate out-of-hole components. But several researchers claim pressure is too low to hold bit on face after impact by percussion unit at bottom.

An example is National Lead's use of I-R's at their Tahawus, N. Y. pit (ilmenite-magnetite in anorthosite, 15,000 tpd). Mine superintendent Walter M. Chapman's reply said the 6½-in. holes on 18x18-ft pattern replaced 9-in. 42T churn drill holes on 25x25-ft for lower cost and better fragmentation results.

But Churn drills did get a boost from work at U. S. Steel's (Oliver Mining Co.) work at Pilotac. Less chipway and better temper on heavier stem and different stroke are some changes that helped in taconite.

Speed and direct operating costs for several types of drills at Kaiser Steel's Eagle Mountain pit (soft to hard hematite-magnetite in fractured quartzite and quartz monzonite) were reported as follows at AMC by Martin J. Hughes, mine manager:

B-E 29T churn on 9-in. holes in soft to medium hard rock—5 ft per hr at $2.25 per ft.

B-E 42T churn on same work—10 ft per hr at $1.65 per ft.

B-E 50B roller-cone rotary on 9⅞-in. holes in soft to medium hard ground—40 ft at $0.90.

I-R Depthmaster down-the-hole percussion on 6-in. holes in hardest ground—16 ft at $1.14.

Two B-E 50B's and one Depthmaster are presently used for production.

At smaller pits where lower benches are the byword, so are percussion drills—usually with carbide bits, often with sectional rods. But coming in are the smaller rotary and down-the-hole units. Most are self-propelled with compressor air components which eliminate air lines.

An asbestos property in British Columbia uses Joy's TM500 percussion drill for 4-in. holes on 8x10-ft pattern

and 30 ft benches. Others in Quebec use the same and Flintkote's manager, G. H. Gibbs, at their pit north of Thetford Mines, cites the G-D Airtrac for 3½-in. holes on 10x10-ft pattern and 40-ft benches. Quebec Iron & Titanium in Quebec uses Joy Challenger mounted on Koehring Dumptor truck chassis, says A. H. Tait, superintendent; Lucky Mc Uranium, Gas Hills, Wyoming, uses rotary truck mounted unit in their sand and silt stones; Northwest Magnesite, Chewelah Washington (magnesite in dolomite and greenstone intrusion, 1600 tons per day) uses 6¼-in. electric-powered crawler rotary and going to 30-ft benches, according to J. R. Brammer, mine engineer.

For block holding, two properties—a southwest copper pit and Kaiser Steel at Eagle Mountain—have joined others, who reported last year on using the Traveldrill. It is a self-propelled chassis with integral air compressor on which is mounted a fully articulated telescopic boom, controlled from a boom end cab where a percussion drill is mounted.

Apparently for both block hole drilling and miscellaneous work another pit of the same copper company reports self-propelled drill jumbo-compressor units with one or two booms. Rubber-tired wheels are preferred for longer moves even over rough ground. Kennecott's Chino mine superintendent, G. J. Ballmer, also showed a locally built one.

Blasting with high-ammonium-nitrate explosives is reported from so many properties this year that the list swamps us. NH_4 NO_3 is a relatively inexpensive but water-soluble, energy-and-gas producing component in many explosives. But the use of the even less expensive fertilizer grade is relatively new as is the preparation on site from a loose running pelletized bulk form. Addition of fuel, diesel and motor oils (used or unused) while loading, to furnish the required carbonaceous material, is even newer.

A sensitive explosive is required as a primer and often as decking in longer holes, to detonate the material. And it is interesting to note that it can be given any desired detonation velocity by using a suitable strength explosive through the length of the charge.

This latter effect was publicized some time back by Atlas Powder as being a cost cutter in the already low cost "alternate velocity blasting" method. In the scheme alternate holes are loaded with low and high velocity explosives so when detonated (with millisecond delays) the ground is stressed by low velocity before high velocity shatters it. It proved itself in an open pit test although no properties have reported its general practice to us recently.

Ammonium nitrate fertilizer has few storage and handling problems—just keep dry, ventilated and away from heat and carbonaceous contamination.

U. S. Steel, Minnesota mines says prilled (pelletized) fertilizer mixed with ordinary fuel oil cuts explosive cost about half.

Anaconda at Yerington, Nev.—uses ½ to 1 gal diesel oil poured into open mouth of 80-lb paper sack of fertilizer as sacks are lowered on top of 25-lb, 6-in. dia 60% gelatin bottom hole primer.

Northwest Magnesite, Chewelah, Washington—Nitro-Carbo-Nitrate replacing ammonia dynamite pound for pound in 6¼-in. holes (30 to 75%); testing prilled fertilizers and working out spacing and powder factor; use jet pump or wagon drill chassis to dewater holes.

National Lead, Tahawus, N. Y.—prilled fertilizer with used motor oil in top of dry holes to replace Nitro-Carbo-Nitrate agent at substantial saving.

Getting away from ammonium nitrate, a bauxite mine using smaller diameter and shorter length holes mentions loading-time-saving 3x16-in. powder is an innovation for them.

Millisecond delay detonation is an entry on most replies. Many pits are using the delay in the Primacord lines.

For blockholing, Ensign-Bickford's Quarrycord—a fast burning fuse with quick easy-to-use connectors—is being picked up by many as a safety feature for linking multi-shot blasts.

Secondary breaking can not overlook the dropball. It has given lowest costs for several pits.

Muck Handling

For moving muck—hydraulicing, dredging, dragline-crane and scraper, wheeled-scraper, and dipper-shovel is the low-cost-wise ranking.

Dipper shovels are most common and trends are similar to last year—bigger buckets. Five to ten yd capacities are fairly standard, 60 yd is biggest. R. R. Williams, general operations superintendent at Reynolds Jamaica Mines Ltd. (bauxite, 3500 tpd), mentions two 4-yd diesel dipper shovels. Two interesting observations here—it is a somewhat larger than usual diesel, secondly most bauxite properties have held to 2½-yd units.

Lightweight dragline and dipper buckets are boosting capacities.

Anaconda at Grants, New Mexico uses mobile generating plants for power to electric shovels.

At the smaller pits, front-end and overcast loaders may be coming into wider production use—like the 4-yd wheeled unit at Eagle-Picher's Nevada diatomite pit and an Eimco 105 at a Canadian asbestos pit. A lease cleaning up pockets at a western copper pit cites the former unit too. Both loaders are fairly mobile and have moderate initial cost.

Transporting by truck and/or trailer dominates replies. Although Chile Exploration, for one, added five new diesel locomotives to their string of 27 electric and diesel-electric auxiliary locomotives, trucks seem to be favorably on the minds of many other large pit people. But conversion is more than a little difficult. Truck-rail combination schemes give some of the desired flexibility.

Concerning rail haul, a large southwest copper pit stated that track maintenance is aided by a variety of machines and they will continue to acquire more. Machines hold down costs and labor in spite of increased mileage of heavy tonnage track.

Our informant at U. S. Steel's Minnesota mines stated over 55% of iron ore plus rock and surface stripping is moved in trucks and tire life is a problem. At least one tire company has on trial, tires with 50% more tread rubber than any previous available. Results indicate double life and no unfavorable comments.

The trend toward 30- to 50-ton truck and trailer units continues apace. The largest reported is 90 tons. The crane hoist side-dump trailers made by Easton are looking good to quite a few respondents. Reynolds Jamaica has a 33-yd Athey wagon topping its fleet of smaller trucks. Kennecott, Ray Mines Div. has really "souped-up" trucks; 34-ton Euclids each with two 200-hp diesels, mostly turbocharged, and 50-ton Eucs each with two 300-hp turbocharged diesels.

Yet there are plenty of smaller trucks being used. Columbia Gypsum, Invermere, B. C. (1,000 tpd) likes their gravity tilt side-dump truck with trailer, giving 25-ton total load for a 2-mile haul.

Truck road maintenance was a topic tackled by a large southwest copper rail haul pit. Calcium chloride moisture holding agent, wood pulp plant waste and water-asphalt emulsion treatments cut, but failed to eliminate, dust. Water sprinkling is needed. Results were best if top 2 to 4 in. is scarified, all +2 in. removed, and palliative

deposited from sprinkler truck. Topping is mixed by grader blade as crown is reshaped.

Tunnels help grade problems. Inco finished a truck tunnel and Utah Copper at Bingham Canyon has another one underway for rail haul.

Belt conveyor schemes through tunnels pop up frequently on questionnaires. Not so much as in use but as of interest. British and German equipment people are really getting tricky assemblies which can turn corners, fold up and traverse indefinite distances.

Tramways in mountainous regions hold their own.

But the use of skip seems the most lively concern. Symposium at Duluth indicated they are a very low-cost scheme. Snyder Mining Co., Whiteside Mine, Chisholm, Minn., reported by C. O. Rodstrom, general superintendent, uses 38 deg skipway with bituminous mix between ties and on shoulders to prevent erosion. Flintkote Asbestos, near Thetford Mines, uses balanced 10-ton skips on 38 deg incline. These can be added to the list of iron pits which adopted such schemes last year. The copper people are discussing them too, as their pits deepen.

Other Topics

For maintenance work Bagdad Copper likes their Austin-Western motor crane. Chino has a similar unit used for short hauls of inconveniently handled material as well. Semi-automatic arc-welding using standard mild steel wire electrodes submerged through a special agglomerated, alloy-containing flux is especially useful for hardfacing according to some testimony. An oiler on dragline at phosphate pit in Florida came up with a proven rope-life-extending practice: to get deeper penetration of rope lubricant apply penetrating oil the day before.

Engineering-wise we hope to get more details on an Arizona pit's so-called "Plan Section Method" of checking mined volumes from plan only. No vertical sections are made, it takes only 25% of time and accuracy is better because errors are more easily detected. Kennecott uses aerial stereophotos for getting rapid low-cost measurements.

Underground Mining

Top items in underground practice are:

Large, trackless open stopes are having a revival;

Coring and boring access openings is increasing;

Longer holes look good for all types of work;

Wheeled, front-end loaders lend themselves to flexible use;

Yieldable steel sets are whipping heavy ground problems.

Development

For vertical work both up and down, operators are keeping an eye on coring schemes. And for conventonal sinking, the Cryderman mucker, which caught many an operator's eye last year, has really been put to work.

Sinking with coring rigs, among other benefits, mechanizes mucking and, for small shafts, eliminates short time-cycles. On shafts through sediments in the Temple Mountain, Utah area, the Calyx shot-coring rig was used. Although they were only 36-in. holes they are serving as production shafts to the small, 125-ft deep uranium ore bodies. Small mining equipment was disassembled and cut into pieces for lowering.

For somewhat larger ventilation and auxiliary shafts other operators are reported pleased with results of using the Zeni (Coal State Construction Co.) 75-in. multiple roller-cone coring rig. A 96-in. unit has been made.

To sink most shafts, conventional percussion drills are most common. Larger shafts use multi-drill jumbos. C. K. Bain (at St. Joseph Co., Mo. and National Potash, New Mex.) and others (in S. Africa) have included built-in, templet-like apparatus to drill a standard round, thereby speeding operations and reducing close supervision.

No new applications of quarry drill rig for drainage, cut relief or blast holes have been reported this year.

For mucking in North America the Cryderman unit — an air-actuated clamshell held rigidly on end of fully articulated boom—has been adopted by many. East Malartic's (Norrie, Quebec) general manager T. V. Nethery says contractor is successfully using 2 Crydermans in 61 deg inclined, 10 x 36-ft, 5 compartment shaft.

AS&R has just started using one on 55 deg 20 x 8½-ft inclined shaft at Page Mine, Kellogg, Idaho. It takes two hours to muck out.

Sherritt-Gordon, according to Angus G. Mackenzie, assistant chief engineer, is sinking the 2,300 x 26 x 18½-ft Farley Shaft at Lynn Lake, Manitoba, with one. Although it has not been used long enough to fully determine benefits, it definitely cuts mucking time.

P. B. McCrodan, superintendent of mines at Falconbridge Nickel, Ontario, reports starting to use a Cryderman in one shaft and having Riddell muckers (clamshell bridge crane) in others.

Other schemes continue in use. Crawler-mounted Eimco overcast shovels worked well in inclined and vertical shafts. An iron mine in Michigan deepened skip pit with slusher and pan. In South Africa, a positive-acting orange-peel bucket on boom seems preferred.

Huge size and great depth of South African shafts has demanded better sinking-cage set-ups. For Anglo-American, Robert Blair devised multiple wrap friction hoist to cut tension. Counterweight in tower controls drum winder for excess rope. Multiple sheaves on stage and headframe also cut rope tension and permit use of rope as guides for several muck cans.

The circular shaft seems to be gaining fans. Ease of lining with many-advantaged concrete and the inherent strength of the arch are factors mentioned. Wall friction of concrete obviated bottom bearer at National Potash.

Some of the advantages of concrete are being gained for structural members too. Precast dividers are continuing to be used in South Africa. In a rectangular shaft, unlined except for gunite over rock bolts, prestressed concrete set members were used by Banner Mining Co. near Lordsburg, N. M.

Raising eliminates trouble of mucking in confined shaft bottom and so it has its advocates if lower opening is available. In raising, likewise, coring devices catch the eye for softer rock. The cores simply fall to bottom for removal.

In Germany two units are reported to have been field proven. One is rotated by 8¾-in. drill stem in a drill hole from level above. Drill hole is tangent to rigid-toothed, 3-ft dia coring ring. Ring has peripheral gear teeth which engage gear on drill stem. An alternative scheme is to use driving motor on rope. The other unit uses multiple roller-cone bits for drilling 5-ft dia raises. It also is hoisted by rope through pilot hole but has built in motor.

Use of large drill hole as burn relief and for passing hoist rope to raising-stage is reported by Roan Antelope, Northern Rhodesia for raising Irwin Shaft. On the Breadalbane Hydro-Electric project in North of Scotland,

Mitchell Construction Co. says a 6-in. diamond drill hole used as above did not act well enough for burn with instantaneous blasting, so delays were used. The 600-ft penstock shaft is being raised at 6-ft diameter and stripped to 12-ft from top down.

A southeast U. S. A. copper mine says they are deepening a shaft 650-ft by following bore hole with small raise and stripping to full size right behind.

For driving untimbered raises between subs in sublevel long hole stopes, Union Carbide Nuclear Co., Bishop, Calif., also uses long holes.

Lateral work headlines boring through harder rock, breaking longer rounds and supporting heavy ground with yieldable steel arch sets.

In April, Doornfontein Gold Mining Co. on the West Witwatersrand, South Africa, claimed a world's record of 1,962 ft of 9x9-ft haulage way in hard rock in 26 days, and 2,238 ft in 30 days. It still does not beat the Czech claim for last year of 2,856 ft of 9.5 x 11.8-ft. But Doornfontein has given a sustained performance. In March it was 1,508 ft, another month, 1,467 ft of 10x10 plus a 41-ft diamond drilled chamber. They used a 12-ft pilot hole ahead of face, 6 air-leg drills, overcast air shovel, and diesel locomotive, working on four shift basis. Harmony Gold Mine, O.F.S., also made a fast drive of 1,392 ft in 26 days.

In Sweden, large tunnel was driven at record speed using heading and down benches drilled with up to 8 machines parallel-mounted on single arm on carriage.

Continuous miners employing cutting teeth on chains or cylinders for all breaking, remain limited to soft rock so far. But extending the Robbins Tunnel Borer to sandstone and limestone is apparently little more than a matter of more thrust. Wear seems to be conquerable. Tunnels at Pittsburgh and Chicago are underway. Carbide teeth on rotating arms scrape kerfs while rolling disks follow to break down ridges in between.

In drilling machines, the airleg-mounted jackhammer has its most avid fans when used for smaller, less accessible openings where labor is not in tight supply. Multi-drifter jumbos tend to get the spotlight in larger openings. Hausherr's faster-drilling rotary-percussion drifter is now on trial at several North American properties, in both hard and soft rock. Plain rotaries —very fast, especially with auger steel in soft rock—are being extended to harder rock with harder carbide bits.

On the other hand, stopers remain just drifting machines in Montana.

For bits on percussion machines more mines are trying simple conical-taper slip-on carbide types. For large burn-relief holes with rotaries, carbide-tipped "Christmas-tree" type has been used. And another source mentions testing a roller-cone surface-drill bit for same use.

Longer feeds which eliminate changes leading up to the customary 8- to 10-ft rods, are quite commonly adopted. Several mines slash openings to larger size with sectional extension rods for 30- to 60-ft long holes. Such steel is available for airlegs as well as drifters.

Ozark Mahoning Co., Rosiclare, Ill., has converted to airlegs with 7/8-in. Coromant integral steel. They tried ¾-in. but life was too poor. Rope-threaded sectional steel is used for long roof bolt holes with stoper and flat flexible steel is being considered for same work.

Rounds are being pulled deeper with single large (4- to 8-in. dia) unloaded hole for burn relief at more properties. At one mine, large hole is jumbo-drilled with percussion drifter while air-legs make other holes. St. Joseph Lead Co. successfully tested a delayed charge at bottom of cut to clear the compacted debris, permitting longer rounds — low sensitive explosive helped.

The idea of gaining efficiency by blasting to a second free face is being challenged. A "no-cut"—no wedge or burn—"concentrated explosive" round is claimed a "profitable" method by Kumao Hino, Japan. Holes are close together and parallel, much like burn, but spacing is not critical, all holes are loaded and they are blasted simultaneously. He says it needs fewer holes, less powder and increases depth of pull.

Smaller holes permit smaller powder. One mine even used ¾-in. dia sticks; although holes break, they found more danger in misfires. Experts have said that this is about minimum size dynamite that will detonate. Explosive in long cartridges has cut loading time at more properties—1⅛ x 24-in. at far midwest iron mine.

New names go on the list that likes Ignitacord—the waterproof, fast and hot burning thermit fuse used to time equally-lengthed capped safety fuse and at the same time permitting a single "spitting" point in headings. One emphasized that "it's cheaper and safer than electric" detonation.

Where electric detonation is used, Eureka Nevada mine, Eureka, Nev., finds No. 18 aluminum annunciator wire gives equal results at 1/3 cost of No. 18 copper.

Ground support in development openings continues to be placed by rock bolts, concrete and and yieldable steel arch sets.

Literature indicates best answer in support is to remove least rock necessary and keep rock in place as much as possible so rock itself carries most of load. And it is important to get a support in as quickly as possible because once rock moves, it has started to fail.

Importance of supporting sides of openings under "pressure" conditions was emphasized in a paper by H. K. Van Poollen at Colorado's Symposium. His model tests conclusively proved that failure of lateral openings starts at the ribs and "horizontal support is as important as, if not more important than vertical support."

For heavy flow conditions, it seems concrete (over 18-in. thick and without steel, if blasting vibrations are strong) is tops. But if pressure goes over design limits the timber-lagged yieldable steel set is the answer. The latter comes in a number of shapes from full circle to partial circle with legs. Members are friction clamped together to permit yielding—periodic tapping with hammer insures slipping.

Concrete is being more commonly prepared at central stations and pumped fairly long distances—most often with pneumatic placers. This year underground plants are mentioned frequently: Kerr-Addison Gold Mines, Ontario, installed one on 300-ft level for drawpoint, bulkhead and support construction. Aggregate raises go to surface. Wet concrete is dropped down to various levels through 6-in. vertical pipe (max. drop 3,700 ft) and trammed out in cars to point of use.

A new southwest copper mine, block caving, drops concrete down churn drill hole to pneumatic placer and on to plywood forms in drifts up to 1,200 ft away. They use no reinforcing. Pattin type (expansion shell) rockbolts with wire mesh hold ground open until concrete takes over.

Falconbridge Nickel has underground plant and placer. It cut time and expense as compared to other support and other concrete handling schemes when constructing winze hoist facilities.

Stilfontein Gold Mine, Transvaal, found the "Intrusion-Prepakt" method very successful for lining-pump station. Washed, coarse mine rock aggregate—plus ¾-in., minus about 10-in. —was placed in form. Surface prepared mortar dropped 3,000 ft through 1½-in. pipe and was air-pumped into forms to fill voids.

One statement was made that air

placing equipment works better than mechanical pumps but air loss and segregation are problems. Additives have helped prevent the latter by reducing water requirements. Armored rubber pipe has found limited success in cutting wear as well as installation time at turns.

Reusable steel and aluminum (lighter weight, though more difficult to refabricate if required) forms are favored if much work is to be done. Often they are mounted on carriages and/or hinged for faster installation.

Prestressing and rockbolting concrete itself were tossed around by some as a means of raising design strength. Elgin Co. used prestressed shaft set members at Banner Mining Co. to reduce mass and suggested using light weight concrete too. At Colorado's symposium, Dr. John Reed (now St. Joe's head of mining research) reported on experiments with prestressing rock surface of opening to boost support ability. He unsuccessfully used flat pressure tubes in plaster models (tubes were in wall, running along length of drift and long cross-section dimension of tubes was radial) but he suggested wedges in drill holes may be practical idea. It could have implications for prestressing concrete too.

Yieldable steel arches got principal mention for slusher drifts in block caving. Full circle is used in heaviest ground. Spacing at Kennecott's Minnesota-Hi is 2-ft; maximum spacing reported was 5-ft.

Three large Southwest copper producers and two large Michigan iron mining companies reply that they get good results with them—moderate initial cost with recovery often possible, and low maintenance.

Falconbridge Nickel says they used an American brand (15 lb per ft, U-shaped channel, J-clamps) in section of moving ground where timber sets needed extensive maintenance and they have needed no maintenance since installed over a year ago. They are now trying a German make that comes in a choice of weights. It is made of high strength, heat-treated steel with a different type clamp.

For another application, AS&R's Galena Unit, Wallace, Idaho, is installing yieldable sets through "heavy" sand fill in cut and fill stope. No comment yet, says N. Visnes, superintendent.

Rigid steel and wood sets have met with some success in fairly heavy ground when wood squeeze-blocks are used. But opening must be restripped whenever blocks are fully squeezed.

Rock bolts are the economic answer to most support problems at most mines. They can prevent "loose" from forming by stressing rock. They effectively tie loose ground together to form its own arch, "tack" large "chunks" to solid rock and, in layered rock they form thicker beam. Their use cuts required excavation size, material and labor. Various materials can be used between them to hold loose ground if necessary.

Patterns for rock bolts are usually a modified 3- to 5-ft grid; lengths are 3- to 8-ft, most often 5-ft; ¾-in. expansion-shell anchored bolts seem preferred to 1-in. slot & wedge now, but 5/8-in. high-strength with expansion shell is making inroads. To prevent rock movement as well as to tack "chunks", with those diameters and anchors, permissible loads are usually 4 to 10 tons per bolt.

Proper tension is controlled by torque on nut, most often measured by wrench length and human strength. But fast machine-tightening, also giving closer control, is taking over. Several devices are available to give better control by eliminating nut-torque measurement which runs into friction error. Spot check-up on proper installation is common, using jacks.

W. J. Burgess, superintendent, Hollinger Gold Mines Ltd., Timmins, Ontario, reports using a ¾-in. mild-steel, expansion-shell roof bolt until early 1956, then changing to 9/16-in. 1040 carbon steel with rolled thread. He writes, it has greater load capacity when tested and costs 5c less per bolt (80,000 to 100,000 bolts per year). But more installation-care is needed (especially getting plate at right angles to bolt) since new bolt appears more brittle and has failed in some instances when bent during installation or loading.

Again in Ontario, Falconbridge Nickel's superintendent of mines, P. B. McCrodan, says: increased rock bolting (now 6,000 per month) accounts for 25% of drilling; high strength with bail type expansion anchor replacing mild steel in 1¼-in. holes.

W. H. Foster, plant manager, Asbestos Corp.'s, King mine, Thetford Mines, Quebec, (asbestos in peridotite) states: more rockbolts—with left hand thread for stoper installation.

Union Carbide Nuclear at Bishop (tungsten in tactite), rock bolts with fence-like, chain-linked, wire mesh according to Lawson A. Wright, mine superintendent.

In Australia, a 5,600-ton non-ferrous operation in shale and in dolomite is replacing occasionally needed timber sets with 45-lb rail sets and rock bolts with and without punched-plate lagging.

Both a southeast U. S. and a southeast Canadian copper mine say more rock bolts. One adds: "and gunite."

Several uranium mines report mudstones make rock-bolts useless. A diatomite property in California cannot use them either. A far mid-west gold mine (in schist) uses homemade rail sets where rock bolts are insufficient. In Scandinavia, grouting schemes have given needed anchorage for bolts in poor ground.

The Scandinavian practice of grouting wire rope in hole was not particularly meant for poor-holding ground but can be used.

Sets are needed if anchorage of rock bolts is impossible. Likewise in loose running ground or fill, sets and lagging are necessary. Steel is cheaper than timber for most American mines, according to replies. With steel, concrete is often used as lagging. Arch shapes are common.

From the Yukon, mine manager, A. E. Pike of United Keno Hill, says they use nested mine rails clamped together to form beam in place of timber caps in heavy ground.

U. S. Smelting, Refining and Mining Co., U. S. & Lark Mine, Utah, uses an interesting pre-blast & pipe-spile scheme for temporary ground support during mucking and timbering when drifting through moderately loose (but not free running) ground. Before blasting, one-inch pipe is placed in holes drilled in face over top of last set-cap and pipe ends are firmly blocked up on cap. Holes are on 8-to 14-in. centers and several feet longer than unblasted round. Scheme is used on ribs too. Mines in iron country also are said to use similar scheme.

At Bancroft copper mine, Southern Rhodesia, drifting through two mud seams (one over 100-ft thick) was whipped with advance grouting and locally made 10-ft dia tube of sectional steel plate rings with face shield —much like vehicular tunnel practice.

Slaking condition generally is combatted with ¼-to ½-in. layer of air-blown concrete. Same material is used over rock-bolted wire mesh if ground is loose. On midwest tunnel job, sediments crumbled in dry ventilation air. So intake air was heavily sprayed with water and vent tubes carried saturated air to exposed face. According to Bemis Bros., supplier of vent tube, scheme was highly effective in keeping ground solid until concreted.

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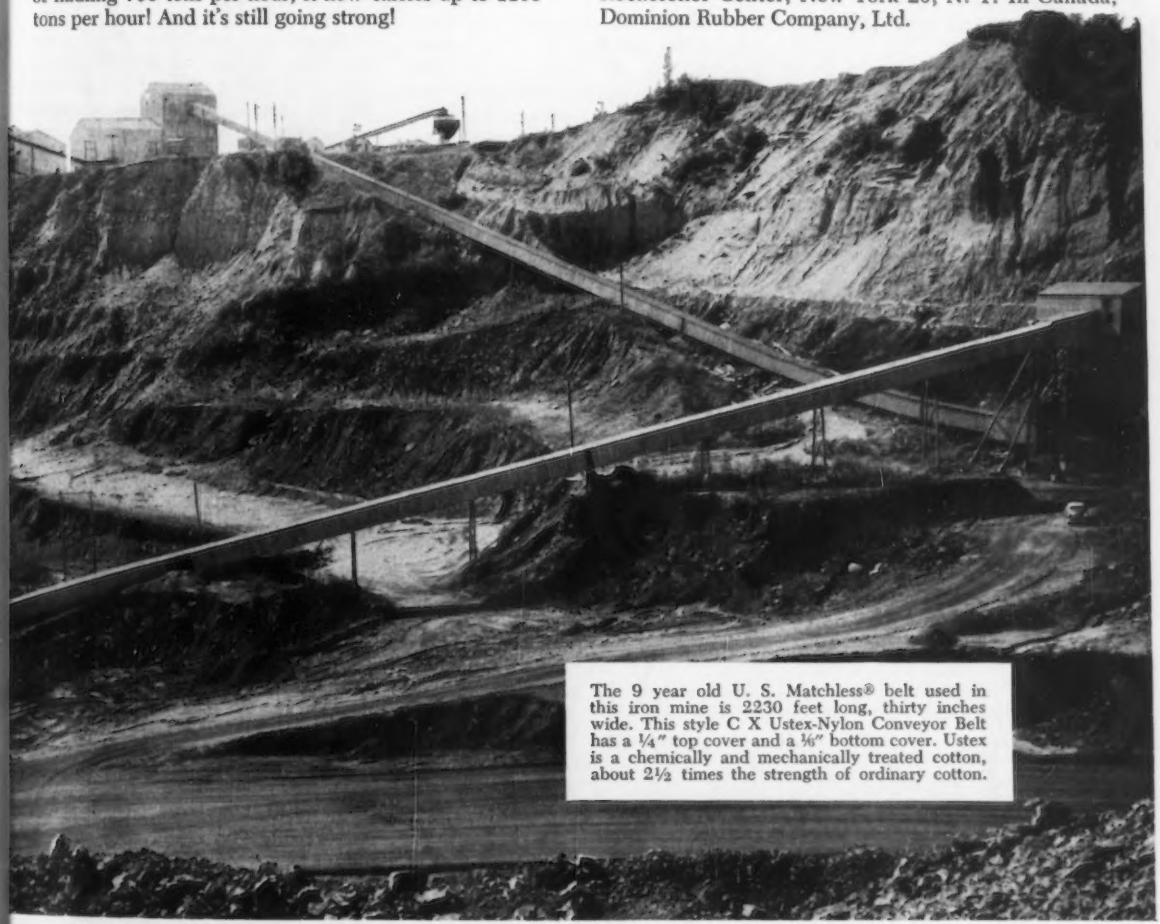

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Mechanical Goods Division

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Handling drift muck seems most notable for the combinations of equipment used for loading. But overcast shovels seem to be masters at this work, including the crawler unit for trackless schemes. Mines, with rail haul, work toward loading and transporting entire round without switching.

Gismo self-loading crawler transport is reported effective in northwest U. S. A. and on Colorado plateau. It loads trains by riding up ramp and along lip of low bottom-dump cars as it fills them. The Whup d' Whup—overcast-shovel casting muck into first rail car while lip-riding slusher scrapes it out and back to fill rest of cars—has worked well but required change in car trucks to cut down derailments at western mine. And a far midwest iron mine is successfully using overcast loader and belt conveyor to load long string of cars.

Slusher set-ups are common in trackless work. And in large headings the short boom shovel is undoubtedly tops. The gathering arm units have apparently overcome the abrasion problem and may be "reckoned-with".

A "better" drift ditch is made of 4-ft long locally precast concrete sections at one Canadian mine.

Stoping

Large trackless open stopes are even giving blockcaving a "run for its money." Of course, they are limited to lower rock pressure.

At Riverside Cement Co.'s limestone mine at Crestmore near Los Angeles, the ore bed dips about 30 deg and is plus 200-ft thick. Inclined haulage way for trucks (including electric trolley type) enters top of mining section as footwall drift. Several crosscut headings (60-ft wide and 30-ft high) are turned off using huge 4-machine Ingersoll-Rand jumbo, and driven to hanging wall. Beyond series of headings (rooms), haulage way curves down from foot wall so hanging-wall drift can be turned off, running back under ends of rooms.

Ends of rooms are broken down to haulage way giving 30-ft bench which is worked back to footwall with down holes. A second 30-ft bench will be worked back to hanging in same manner. Floor pillar will be left below 90-ft high open room. Haulageway continues to spiral down at same end of mine to allow foot- or hanging-wall drift to be turned off at proper elevation.

Eagle-Picher in Upper Mississippi Valley district is using a similar scheme without spiral haulageway since ore horizon is flat. C. O. Dale, manager, puts it simply: drill jumbos ramp up to top of ore and after top cut, bench down using three to four benches for 60-to 80-ft height. Short-boom shovels, front-end loaders and overcast-shovels load into trucks.

Tri-State Zinc is another low-cost, similar operation in same area. But a shrinkage scheme is used in which drill jumbos on crawler tractors ride broken muck as they work back and forth drilling inclined up-holes.

A copper mine in Canada uses a trackless heading and benching scheme with wheeled Drillmobiles for horizontal holes and an Airtrac for vertical. They prefer horizontal holes at present.

Though somewhat smaller, the uranium mines in Big Indian, Utah district such as Utex's Mi Vida and Continental's No. 1, employ rail haulage underneath room & pillar stopes in thin flat ore horizon. Slushers, Gismos and various front-end loaders with and without trucks or shuttle cars dump into short raises. Two other mines in district are reported using a longwall scheme. Long face between parallel drifts retreats from ore limits as back caves behind.

Longhole stoping from sublevels or raises seems a common method now. Drilling fan, ring or parallel patterns depends mostly on vein width. Another factor is that gain in effective blast hole footage with parallel holes is off-set by added development. A "newer" mine in British Columbia adopted horizontal fans from footwall raises. Union Carbide Nuclear, Bishop, California, reports ring and parallel downholes from sub-levels. So does an Australian mine. International Nickel at Sudbury, Ontario, has eliminated the BX diamond drilling for extra-long holes (which eliminated sub-levels between 200-ft levels) by percussion drilling longer up holes from undercut. And Inland Steel uses long horizontal holes for pillar recovery.

A large non-ferrous Australian mine uses sub-level, shrinkage, and cut & fill depending on ore occurrence. In their sub-level work these things have lowered costs: concentration of operations to minimize service and supervision; specialization of jobs results in faster training and lower supervision needs; mechanization of sub-level development; larger facilities and larger equipment to handle larger size ore; "continuous trough undercutting" (rather than bells, we suppose); parallel hole patterns; and longer—140-ft, 2¾-in.—percussion drilled holes which increased sub interval. This mine has also replaced down hole benching scheme in narrow orebodies with shrink stoping.

Sub-level caving on the Geobic iron range in Michigan, a large company uses longholes—"faster drilling, better blasting and safer."

Shrinkage schemes are also finding longholes advantageous for same reasons.

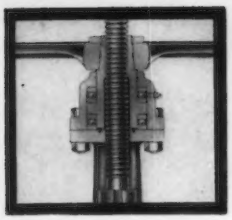
An unusual cut & fill method is being used at United Keno Hill Mines, Yukon. It is used in narrow veins where ground is bad; men are always under timber. They call it a "down-dip slotting" method. Raise is driven straight up dip, then down stripped on one side; draw hole is cut at bottom. Second down slice is made, and new drawhole cut. Then raise is filled and first drawhole becomes manway.

Magma Copper Mine in Arizona also uses similar up-dip square-set scheme in wider veins. New slice or slot is breasted out from previous timbered slice, while going up dip. It reduces the open gap between supported back and face. If vein width is several sets wide, it also permits partial filling of work slot.

At Brittania Mining & Smelting Co. near Vancouver, British Columbia, it is reported that on the large Bluff orebody, millsecond delays have permitted continued use of large "powder blasts" at depths. In this scheme, cases of explosives are concentrated in pockets at ends and other points in grid of drifts and crosscuts. In one stope having 65 x 205-ft plan, burden below lateral openings averaged about 25 ft. Blasts had more than 40% overbreak for powder factor of 0.6 lb per ton.

But never-the-less, block caving is the real bulk mining method. It seems more generally accepted that draw control is not the big problem that it was considered only a few years ago. At Colorado's symposium, Professor P. B. Bucky of Columbia told about model tests on drawing. He indicated that once capping was safely caving orderly drawing schedules gave no better extraction nor more dilution than a random selection. His experiments also show that crushed ore does not build up hydrostatic head. He expressed a view that boundary cut-off stopes are needed only in certain cases.

Others commented on many topics, such as: drawing and caving appears generally vertical with later sloughing of sides, but Van Poolen's model work showed failure pattern rather



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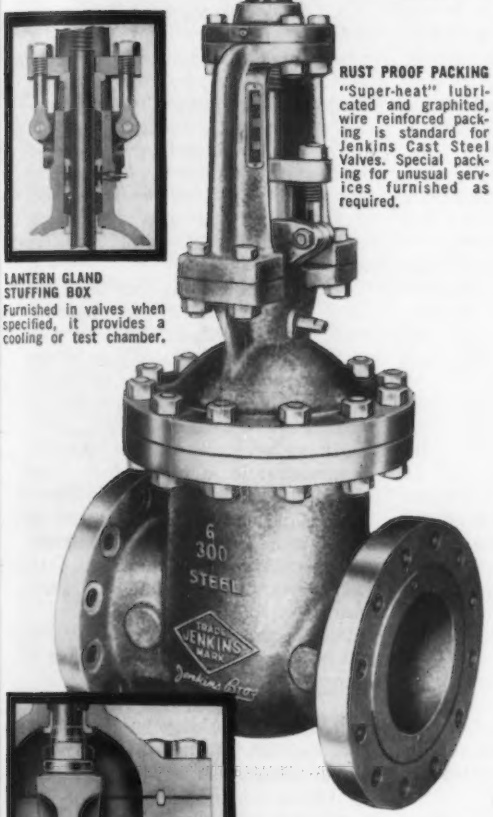

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Furnished in valves when specified, it provides a cooling or test chamber.

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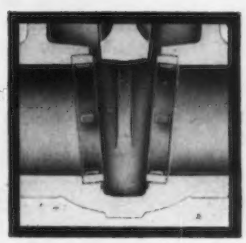

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Wedge lifts out of flow when valve is full open, permits free, unobstructed flow.

for design features that deliver
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JENKINS CAST STEEL VALVES

The details shown are only a few of the many design features developed by Jenkins valve specialists to make Jenkins Cast Steel Valves a match for the most punishing requirements of higher pressure, higher temperature services.

You can get the required combination of casting alloys and seating metals for services up to 600 psi — 1000°F. With any valve specified, you get the *plus* of Jenkins *extra value*, — in performance, in lasting economy.

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PATTERNS	Gates 2" to 24" — Globes 2" to 10" — Angles 2" to 10" — Swing Checks 2" to 12". Non-return, stop and check Globes and Angles, 4" to 10" Screwed, Flanged, or Weld Ends
PRESSURES	150 lb. — 300 lb. — 400 lb. — 600 lb.
PRESSURE CASTING ALLOYS	Carbon Steel — 150 lb. Valves Carbon Molybdenum Steel — 300, 400, 600 lb. Valves Chromium Molybdenum Steel (when ordered)
SEATING METALS (in various combinations)	H Monel 13% Chromium Stainless Steel Carbon Molybdenum Steel, Stellite faced AISI Type 316 Stainless Steel

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It describes all patterns, casting alloys, and seating combinations, with details of the *extra value* design and construction features. Gives pressure-temperature ratings, dimensions, and other technical data. Get a copy from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.

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heart-shaped with high wide sides; maximum height of single block—determination of which is problem at San Manuel—is limited by collapse of access openings, dependent on pressure developed in specific rock at property; minimum caving areas are as small as 10x10-ft at many properties.

At the meeting, Martin Hannifan, Anaconda Co., Butte, Mont., said change to grizzly-controlled slusher system and concrete support greatly improved efficiency and costs. Of course many operators are aware that slusher schemes increase support problem and some say, if too bad, they may have to return to gravity (raise) system.

In mining with cutting devices, a phosphate rock planer has been developed by U. S. Bureau of Mines and Montana Phosphate Products Co. It is used for long wall work in dipping beds, it employs several pneumatic spade-tipped paving breakers to wedge off face as carriage is cable towed updip along face.

For room and pillar work in Carlsbad district, Potash Corp. of America is still keeping its own designed and made continuous miner under wraps although a patent has been issued. The 18 ton unit reportedly can crawl steep slopes and uses very articulate cutting head consisting of horizontal rotating drum, inset with conventional carbide teeth. Scraper and drag chain conveyor apparently moves ore to extensible belt system. Belt system will reach 7¼-mi. from shaft.

Union Carbide is continuing to perfect the remote controlled (from surface) continuous coal miner-extensible belt conveyor unit they have developed in their West Virginia mines. The boring type cutter enters side hill outcrops and can go in 1000 ft.

Augers to 5-ft dia have been used by others in similar work to penetrate to 150 ft.

Drilling in stopes follows the practice mentioned in lateral development and above. Major impression is that the holes get longer and longer. In open stopes jumbo feeds to 12-ft are common; but 18-ft is longest. Even semi-auger rotary machines are probing to 50 ft. Likewise in shrinkage stopes long holes are getting into range usually reserved for sublevel work.

Long blastholes in sub-level methods no longer mean 30 to 50 ft holes. With the wider use of the 4½-in. percussion drills it means up to 150 ft. The diamond drill is no longer considered necessary or economic for such work. One southeast U. S. copper mine recently converted completely to percussion drills. So did Inco (see above). While speaking of diamond drilling, a midwest mine reports oriented bits have shown no overall improvement over conventional set bits. In a Michigan iron mine, 250-ft percussion holes have been drilled with 4½-in. percussion machine for drainage and for power cable installation.

Starting with the bit, tungsten carbide inserted detachable type is standard. Titanium carbide is claimed to be even better by a South African manufacturer. The thread connection is being battled for supremacy by the simple conical taper slip on. Many mines are testing them for shorter holes. Some makes have brass or copper shim to cut fretting and to aid removal. Some parties claim shim is unnecessary with proper taper.

Falconbridge Nickel is fully converted to bit with 12 deg taper. They prefer forging taper on rod over grinding or machining—finding such practice lengthens rod life. Apparently heat-treatment is carefully smoothed out to prevent weak notch. A Montana mine has had favorable performance with same bit. And a Michigan mine is testing them along with carburized, case-hardened alloy drill rods.

Another Canadian mine says they have had considerable success with the one pass "Tee Cee" bit with 11 deg. conical taper and shim. It gives good footage, eliminates bit handling, sharpening, etc. A Colorado mine tested them and converted entire mine from plain steel throwaway. Production rate jumped 20% with only slight increase in drilling cost. Maintenance on drills dropped.

A Michigan iron mining company says 3 deg taper bit proved effective in development work with carbon and alloy steel. But they mention it is unsatisfactory to use with extension rods in stoping.

Several Canadian mines mention using taper bits and couplings to reclaim used and broken integral steel by simply grinding taper on ends.

One Canadian company emphasized that they remain on list of those that save by making own carbide bits.

Climax Molybdenum research indicates bits could use more chipway space, waterholes closer to face and harder carbide. From England, Dr. E. W. Inett reported on tests which showed advantages of cross bit over chisel—faster, wears less. He also suggested a percussion bit with more chipway space.

For long holes bits about 2¼-in. dia are mentioned most frequently. An Australian mine used 2¾ in. bits for 140-ft holes. R. D. Satterly, manager of ore mines, Inland Steel Co., replies that 3-in. are being used for theirs.

Steelwise, little was said this year. Alloy steels increase life but need more care in handling. Hardening or stressing surface by rolling and carburizing is accepted as life boosters by those that investigated. Carburized alloy steel is said to give 10 times footage of plain carbon. The small ¾-in. steel for air-legs was too poor in life for one company (see Development) but others use it successfully. The Swedish ½ x 1-in. flexible steel for 22-ft air-leg holes is in use on undercutting at asbestos mines in Quebec.

Machines have seen no revolution this year. The Hausherr rotary-percussion drifter type is under test in U. S. & Canada. Speed looks very good and bit fracturing problem is being solved with improved bit and closer operating control in erratic ground. Electric pump hydraulic mechanisms are being used on some rotaries.

A new southwest copper mine has some tests underway on machine modifications. Six-in. long chucks (rather than usual 4¼-in.) on air-leg and drifters for collared 6-in. shank on 1-in. quarter octagon steel—no conclusions yet. (Long shank gives better guidance and longer chuck life; disadvantage is in longer front head which decreases feed length.) Combination of jack hammer front head on stoper with anvil block removed and 4¼ in. shanked and collared 1-in. Q.O. steel, gives faster drilling but faster wear on chuck.

For secondary plugging on grizzlies and in draw points, this same mine is using 15- to 30-lb jackhammers.

Blasting stopes with large blasts is becoming less unusual. Electric millisecond delay detonators make it safe. In Mexico, a copper mine reports one shot which broke over 600,000 tons plus 400,000 tons of overbreak. Where millisecond delays have not been used before, usual comments are like E-P's in Wisconsin-Illinois district: trying millisecond delays with considerable success—better fragmentation and a little lower explosive cost.

Connecting wire of aluminum is entering the competition. One mine says its cost is ⅓ that of copper.

Powder diameters which are closer fit give efficiency in blasting with less tamping necessary. But rough holes are an obstacle. Southwest Potash at Carlsbad may have run into that problem. John Sowers, mine superintendent, says they tried 1¼- and 1⅛-in.

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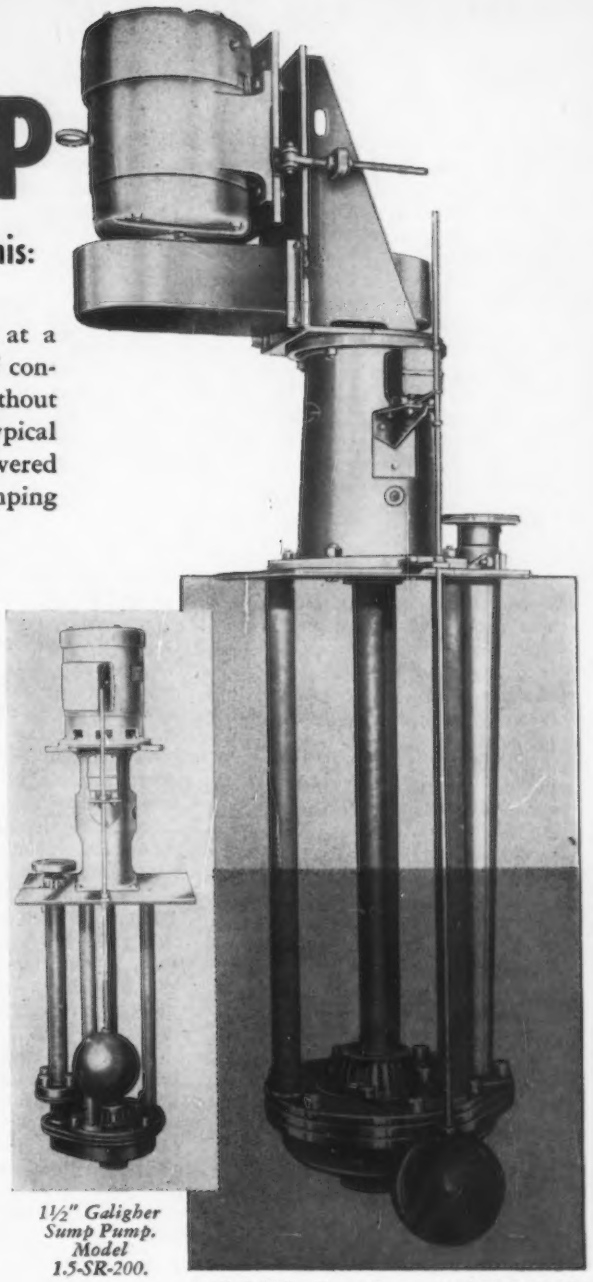
SUMP PUMP

stands on such challenging records as this:

An installation of four Galigher Sump Pumps at a Colorado mill has just completed 10½ months of continuous operation handling abrasive material without an hour of shut-down for repairs. This record is typical of the dependable on-the-job service being delivered at scores of other mills where uninterrupted pumping is vital.



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We also manufacture the well known VACSEAL Pump for material handling and corrosive solutions. Sizes 1½" to 8", capacities—10 to 3600 GPM

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size but standardized on 1-in.

Cartridge 1½-in. diam up to 4½-ft long was said to have been used at Malmberget in Sweden. They also use Nitroglycerin AB's pneumatic loader in which wrapper-slitting knives are on inserted end of sectional brass tube and hinged clamp-over cap with ¼-in. compressed air hose attached is at other end. Tube, 1¼-in. O. D., is used in 2¾-in. holes. Device gives faster loading and better tamping.

For secondary blasting, a Quebec copper mine reports using 2½ lb package of 75% powder to mud cap in grizzlies and scrams. They like Ignitacord for pole blasts in draw points. A southwest U. S. copper mine brings up testing shaped charges for secondary work again.

Ground support in stopes is somewhat different than in access openings. For temporary support during excavation, rock bolts work very well. But if permanent support is needed, hydraulic filling using mill tails is a logical answer. Many use it. Falconbridge Nickel is supplementing tails by grinding sand and gravel. Some old workings were filled with 25,000 tons of tailings carried 2-mi. in ready mix concrete trucks to keep pulp agitated. Another mine uses compressed air agitation in storage tanks.

U. S. Smelting at Lark, Utah, uses chain-link fencing, 4- and 5-ft wide, spiked to stulls, 6- to 8-ft apart instead of 3-in. timber to hold back development-muck fill in stopes. It's easy to transport, handle and install.

Although steel is generally reported as cheaper in drift sets, considerable timber is used in some stoping methods. Timber framing machines are proving cost cutters for large consumers.

In non-ferrous mine in Montana, they simply fill empty shrink stopes by blasting hanging-wall with long holes. They also use tear drop pillars in shrink stope to reduce wall pressure during extraction.

St. Joe is continuing experiments with concrete pillars in their flat lying orebodies.

For temporary support when removing pillars, rock-bolts are one answer. Continental Uranium uses them. The coal mines have developed a number of yieldable, self-moving props for somewhat similar work. One operator mentioned them for long wall mining of thin flat uranium ore. They eliminate pillars.

In South African gold mines, pneumatic tailing stowers seem to be gaining a preference. Hydraulic scheme would probably mean too expensive pumping of drained-off water.

Stope muck handling replies touch upon a variety of schemes. Slushers with ramps or chutes are handy in almost any situation. But the one that seems outstanding is widening use of wheeled front-end diesel loader as self-loading transport in trackless mining methods.

At Four Corners Uranium group near Green River, Utah, Edward L. Clark says small unit does excellent job. They are equipped with scrubbers.

Ozark-Mahoning at Rosiclare, Ill., uses wheeled Hough HMD Payloader to load dieselized Ford trucks. They use an HA unit to load hoisting cans on flat mine cars at another mine where headroom is lower. In the latter mine, its fast mobility makes it good for track cleanup too. The company also uses a slusher-ramp loader on electrified truck chassis.

A cinnabar mine in Nevada is trying a rubber-tired front-end loader for loading and transporting—no conclusions yet. Wisconsin-Illinois operator says they are high cost loaders but fast mobility is help.

A Canadian open stope copper mine prefers electric dipper shovels but also uses front-end wheeled diesel and overcast crawler electric loaders.

A uranium mine uses slusher to gather ore during pillar removal and front-end loader trams the ore short distance to car on incline. Another slushes directly into 700-lb hoisting buckets from stopes adjacent to 4x8 ft shaft. Standard Uranium, Utah, uses dragline crane to gather pillar ore under bad back.

Gismo self-loading crawler transport is considered good for short trams in flat stopes of medium height. A self loading shuttle car is reported to have been developed by Western American Industries, Longmont, Colo., for thinner beds.

A Michigan iron mine is testing a chain- and pan-like conveyor for gathering from sub-level draw points.

In cut and fill stopes, muck handling highlight is sectional, circular steel chutes. Dayrock mine uses them. And Inco reports on their 3¾-ft dia chute in which they back up bolt assembled, sections of ¼-in. steel with 6-in. concrete made from fill material.

General Topics

Transporting muck received these interesting comments for rail haulage: In Michigan, 6-ton diesel locomotives are very satisfactory; more are ordered. A Manitoba mine is gradually converting to diesel locos. In southern Illinois a longer tram made battery locomotives inefficient and converting one to diesel driven dc generator proved so successful more are planned. In Ontario, combination battery-trolley locomotives permit using battery for safer loading at scraper chute.

At Sudbury, Inco has tested and adopted maintenance-cutting rubber coupler-draft and chassis-suspension gear in place of coil springs on heavier equipment (110 to 188-cu ft Granby, and 260 cu ft tipple cars). An Australian mine enlarged equipment and increased gage from 2-ft to 3-ft. Central African mines are using 91-lb rail, speeds to 35 mph. At Southwest Potash 17-ton cars and 48-in. gage are used for trolley haulage.

In southeast U. S. a copper mine likes "better-cleaning" side dump with down-swinging doors. Inland Steel has traveling device for dumping roll-over cars in trench parallel to track. Another Michigan mine says Canton track cleaner and railcar mounted hydraulic back hoe ditch cleaner have proven themselves.

For conveyor haulage, Magnet Cove Barium suspends conveyor from roof bolts for simpler installation and better housekeeping. International Salt at Detroit is trying Goodman rope belt conveyor as link in main belt haul system to get experience. It is reportedly easy to install and takes shock loads well. Potash mines are using it. It is quickly extended. A Michigan iron mine is continuing with installation of main haulage by belt. White Pine is installing two from panels to underground crusher.

German and British manufacturers have developed innumerable designs for curved, steeper and longer conveyors. Most use separate components for load carrying element (belts and pans) and for motive transmitting element (ropes, tiny-wheeled carriers).

At some mines trucks of heavier, highway types are being adapted to underground use. Riverside Cement uses a 24-ton Kenworth-built electric-trolley dump and reports them faster than diesels. They also use tight turning Tournapull rear dumps. But at other mines, St. Joe for example, units are being custom tailored to fit smaller access openings.

Hoisting finds a definite trend to bottom dump, swing out or swing-door skips. Deep mines and shallow mines both report the change-over.

The headframe mounted friction drive hoist continues to hold interest. There seems to be a difference of

BEAR IN THE BORROW PIT

THIS D9 LOADS SCRAPERS WITH 25 HEAPED YARDS IN 45 SECONDS

Phil Dudenhoefer, grade superintendent, knows from production charts that the D9 pusher loads more yards faster, at lower cost.

Working near Eau Claire, Wis., on a highway relocation job, L. G. Arnold, Inc., cut cycle times and boosted yardage with a Caterpillar D9 Tractor push-loading a CAT* DW21 and No. 470 Lowbowl Scraper.

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Phil Dudenhoefer, grade superintendent for L. G. Arnold, Inc., says, "I've got both feet right in the dirt, where I record output and performance of every machine. With the D9 as pusher, the DW21-No. 470 unit is outproducing by far any other equipment on the job."

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Your Caterpillar Dealer can show you actual performance records of higher production at lower cost per yard. He'll give you a demonstration right on the job. And he stands behind the long life of every machine with reliable service and parts you can trust.

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HEAVY-DUTY EARTHMOVERS FOR THE HARD WORK

opinion over concrete or steel headframes. Most have been concrete, but better vibration resistance and easier modification are advantages of steel.

In Britain, locked-coil ropes are favored for friction hoists because of increased wearing surface. Conductor cored hoist ropes for communication is reported in use at several mines.

At AS&R's U. S. & Lark mine they use a skip-cage combination in vertical shaft and have added a removable second man deck in between. After crew is unloaded, deck is rolled out and hung alongside collar.

At Boliden, Sweden, unit load measuring devices and controls make hoisting really fully automatic. In U. S. similar devices are reported from two properties. It is considered necessary to crush muck first.

Scrapers are being used to load skips at a large iron mine in U. S. And Getchell Mines in Nevada uses scrapers to load trucks from where skips dump directly onto surface pads.

For large hoist installations New Consolidated Goldfields Ltd., South Africa, deserves mention. It is reported that the geared double drum unit is driven by four 5200-hp ac winders having Ward-Leonard controls and dynamic braking. It is believed that this mine also has a tower mounted automatic friction hoist driven by a 4300-hp ac motor.

Rope speeds at large, deep installations commonly reach 3000 fpm. Some direct acting hoists have topped 5100 fpm maximum. Mining laws have generally limited man-cage speeds to 1800 fpm but one foreign report mentioned a new deep shaft hoists at 2400 fpm.

Pumping continues to go automatic at many mines. Oil well mud pumps cut out sludge hoisting.

Movable substations for electric power in widespread workings are relative newcomers.

Compressed air and water is being distributed in plastic pipe at Asbestos Corp.'s King Mine. Large (20,000 cfm ±) rotary compressors are replacing reciprocating units in Canada and Australia. They reportedly are less expensive, cut maintenance, take only ⅓ space and permit better control. Power consumption is only slightly higher. Minerva Oil uses movable electric and diesel compressors, keeping them within 300-ft of face.

Three items are mentioned that are cost cutters around the shaft collar: self-service cap lamp rack is faster and cuts maintenance for New Park Mining Co.; timber trucks that double as shaft cages reduce handling at two Canadian mines; packaging timber by strapping and using fork-lift trucks is a familiar practice, but several new advocates applaud it for pipe and other supplies too.

With all the telephones and radios that are being installed, control problems are fast vanishing.

In engineering, one mine mentions they have joined ranks with others that use non-college graduates for all routine work.

In labor relations and management, comment by mine after mine shows the awareness of all to benefits of refresher courses for all employees and training programs for new and prospective or newly promoted men in all grades. Incentive bonus' boost efficiency most when rates are set with some permanence through industrial engineering methods. One Canadian mine hired consultant to train and set up permanent staff consisting of several observers under an engineer.

Safety and health moves ahead with new practices. In British Columbia, to cut noise and boost man-efficiency, 50- to 100-ft exhaust hose was attached to diamond and percussion drills without noticeable drop in machine efficiency. An American copper mine put mufflers on chute cylinder exhausts. Safety couplers on muck cars in case rotary coupler opens are used at latter mine. To measure radon concentration in inactive mining areas, Four Corners Uranium has set up base stations.

Inquiries concerning the microseismic detector-recorder for forecasting rock failure, indicates worldwide interest. It is being used in U. S., South Africa and Australia.

For low pressure ventilation, Minerva Oil uses 4- and 5-ft polyethylene tubes stretched on wooden hoops. They work fine so far—economical, easily installed and moved.

Intake air is heated in winter at International Nickel, Sudbury, Ontario, by several means. At two mines steam coils are used; and at a third, a direct oil-fired heater. At Creighton, water-filled, finned-tube heat exchanger recovers heat from warm exhaust air. At Frood-Stobie a simple water spray freezing scheme in two large stopes raises temperature to 30 deg F. In summer the ice formed cools air.

Joy's highly compact Microdyne dust collector is expected to prove beneficial on cutting and loading equipment.

Big axial flow ventilation fan at Zinc Corp. Ltd., Australia, is designed to exhaust a maximum of 900,000 cfm at 4.2 water gage. Propeller is 209-in. dia with variable pitch blades to correct seasonal variations and variable speed to regulate volume. It is mounted horizontally on surface.

Lighting with conventional 110 v. lamps plus air driven floodlights are being tried in stopes and headings at U. S. and Lark Mine in Utah.

Canadian Johns-Manville's underground flush toilet system with septic-tanks is claimed completely successful.

In the safety training field, five-minute weekly discussions by supervisors helped at one mine. A gold mine in U. S. has produced its own safety movie in sound and color. At an iron mine, 45% of employees were trained in accident prevention during 1956—a follow up on 100% training in first aid in 1954.

Employment of a full time safety engineer with part-time helper showed quick results for a mine in far west that had none before.

Bureau of Mines recent tabulation of number of accidents for 1932 through 1954, shows where efforts should be concentrated:

PER-CENT	CAUSE	FATAL	NON-FATAL
15.8	Falls of ground	1,136	36,618
13.6	Handling materials	50	32,534
11.6	Hoisting and haulage	588	27,320
8.2	Falls of persons	523	19,155
5.7	Machinery	126	13,582
0.9	Explosives	331	1,903
0.6	Electricity	121	1,292
43.6	All other	531	104,126
100.0	Total	3,405	236,530

Some Over-all Views

Voicing opinions on trends in mining practice, university and Government mining men generally include reference to research. A typical one from Prof. A. W. Asman of Penn State mentions wider application of industrial engineering, mechanization and precise scientific methods to solve operating problems. Paul T. Asman, chief mining engineer, U. S. Bureau of Mines, comments on the Bureau's effort to develop and stimulate mining research. He calls attention to the improving situation. Examples are Colorado and Missouri Schools of Mines' symposia on Rock Mechanics, University of Minnesota's on drilling and blasting, and the number of mining companies now employing full time research staffs. He also mentioned the very close cooperation of mining companies on Bureau studies—such as the current one on blockcaving. In his summary, Professor W. Been of Michigan Tech said this: improved and wider training to better use present facilities holds more promise than any technical advance this year●

When you're CORE-DRILLING, it's no gamble with these 3 aces in the hole

22-HD The rugged, heavy-duty model. Single-line capacity—2,250′ with AWX fittings. Also available as truck-mounted drill or on twin-column mount for underground operation.

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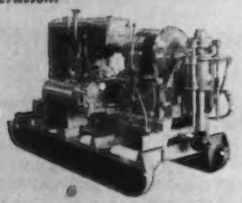

12-B Extremely portable, weighs approximately 1200 lbs. Capacity—1,250′ with EWX fittings. Also available on twin-column mount with air motor drive for underground operation.

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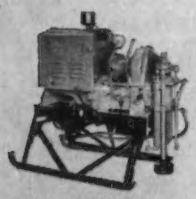

No. 7 The lightweight, easily transportable model. Can be taken underground or transported by airplane, boat, or even muleback into remote areas. Capacity—500′ with EWX fittings.

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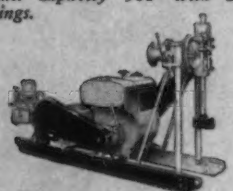

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With capacities ranging from 500 to 4000 feet (the 22-HD, with larger power unit and using multiple lines, has drilled to depths greater than 4300′) there are Joy diamond drills applicable to almost any coring job. And they'll do the best job for you. Here's why . . .

EXTREME PORTABILITY Skid mountings, compact design, and rugged construction make it possible to drag Joy diamond drills into some of the most inaccessible locations.

VERSATILITY Because they are available with either hydraulic or screw-feed swivelheads and with a choice of gasoline, electric or air power, Joy core drills can fit into any drilling program without expensive preparations.

Check your drilling needs against this group of outstanding drills. One of them will be suitable to your needs and it will do an accurate, economical job of proving the mineral value of your property. Write today for literature on the machine you need to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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OPERATING IDEAS

Acid Trailer Saves Handling

ENDING MULTI-HANDLING of acid barrels and the accompanying hazard to handlers has resulted from adopting a tank trailer at Kennecott Copper Co.'s Nevada Mines Division plant, McGill, Nev. Unit was suggested by general safety committee.

Concentrated sulphuric acid is used to adjust pH of cooling water in power plant equipment. Formerly, drums shown in photo were filled every ten days at central storage tank, moved to boiler room in power plant, equipped with valves and moved again—to cooling towers. There was man-handling at each stop.

Now, trailer is filled at central storage and moved to cooling tower. At the turn of a valve, acid flows into cooling tower storage tank. No man-handling results in faster, cheaper and safer operation. (From "Kennevadan," employee magazine.)

Carrier Goes Down Calyx Hole

SMALL DIESEL DUMP truck was cut in pieces and lowered 150 ft through 36-in. Calyx drill hole at an underground uranium mine in Temple Mountain, Utah, area.

According to reports, it was fairly easy to get the Scoot-Crete D-70 down. First it was disassembled into major components. Then, with torch, frame was cut in half just behind box and box cut in half just below name. At bottom of hole, components were welded together and reassembled. Getman Bros., South Haven, Mich., makes the Deutz diesel-equipped, three-wheeled, gravity-dumping, ¾-yd unit and other models.

Shot-cored hole is used as entry instead of larger and more expensive conventional shaft. Truck hauls ore to tiny shaft for hoisting to surface. Mechanical mucking is done with small slusher and wheeled loading ramp.

Air Drives Handy Light Plant

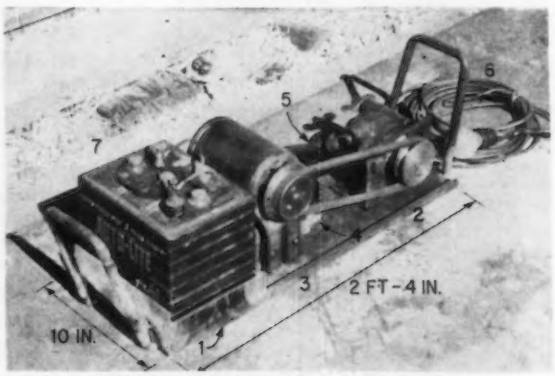
FABRICATED from salvaged parts, this portable light plant can give light wherever there is "air." Unit was used for underground exploratory core drilling in places remote from electrical power. It has many possibilities for supplementing cap lamps and other lighting equipment.

While small capacity generators powered by pneumatic motors are on the market, they are not always readily available. A drilling contractor operating in northern Mexico found his answer in this unit.

Basically it is a salvaged auto electrical system mounted on a base plate of salvaged 10-in. channel. Generator and motor mounting plates are angles welded to base plate on centers corresponding to V-belt drive. Generator, from wrecked Ford car, has mounting frame bolted to angle. Drill feed motor has reducing gears removed and pulley added. Motor housing is bolted to angle. Motor speed without gears is 300 rpm. Air control is fixed at wide-open position and blanked off to prevent reversing. Air is controlled by a globe valve on intake pipe.

Storage battery is necessary to adsorb power fluctuations resulting from variable motor speed caused by changes in compressed air volume and pressure. Plant was in use for several months and kept battery charged at a satisfactory level by running generator through lunch period and occasionally between drill shifts.

Only thing purchased was storage battery; everything else was salvage material from scrap pile. Plant was assembled by drill repairman at odd intervals totaling 8½ hr. Approximate weight is 100 lb.



1. **Base**—piece 10-in. structural steel channel with welded-on battery tray edging of scrap plate, handles of scrap pipe and motor and generator supports of scrap angle.
2. **Air motor**—P.F.2 salvaged feed motor from Ingersoll-Rand DA-30 rock drill, gears removed and 3½-in. pulley added for Gates Truflex 3350 automotive V-belt.
3. **Generator**—Ford 6v auto.
4. **Voltage regulator**—standard 6v auto.
5. **On-off switch**—standard wall.
6. **Extension cord**—Tirex with weatherproof socket and 6v screw base bulb.
7. **Storage battery**—Auto-Lite 6v auto.

Financial Aid to Higher Education

A Fine Start, But...

This editorial has two purposes. The first is to salute American business for the fine start it has made in helping to relieve the financial plight of our colleges and universities. The second purpose is to stress the importance of having business provide more financial aid, and soon.

How Business Helps Higher Education

Business contributions to higher education doubled between 1950 and 1955. They jumped from $40 million to $80 million. Preliminary figures indicate they will be even higher this year.

Business firms have also shown a lot of ingenuity in devising different ways of making their contributions. The methods range from a matching of an employee's contribution to his particular alma mater to wide diffusion of the money through state and regional money-raising associations of colleges and universities. Thanks to this ingenuity, business firms now have a wide choice of ways by which to give effective aid. The way most appreciated by college administrators is the making of gifts unrestricted as to the purpose for which the money is used.

Imposing as it is, however, what business has done thus far is only a good start. Only a tiny fraction of the total number of business firms in the country are giving direct financial help to our colleges and universities; and this fraction includes fewer than half of the hundred largest corporations in the country. Also, the amount of financial help being provided by business constitutes only a very small fraction of what is needed.

Why Colleges Need More Aid

Right now our privately endowed colleges and universities need about $350 million more in operating income a year than they are receiving to enable them to pay decent faculty salaries and be in tolerably good working order otherwise. The reasons, including a severe decline in the purchasing power of their endowment income because of price inflation, have been dealt with in the previous editorials in this series.

In addition, these institutions, together with the tax-supported schools, are faced with a tremendous increase in enrollment over the years ahead. With both a rapidly increasing population of young people and an increasing propor-

tion of them going to college, this year's enrollment of 3.2 million students is expected to reach 4.0 million by 1960, and to be doubled by 1970.

For the next ten years our privately supported colleges and universities must have an average of about $400 million a year above what they can be expected to collect from tuition fees, income from endowment funds, etc.

This figure of $400 million does not include what is needed for new buildings and equipment. It also does not include help for tax-supported schools above what they get from taxes, fees, etc. Business has given and will continue to give these schools substantial aid. Indeed, almost 25% of the financial help from business for our colleges and universities went to tax-supported schools in 1955.

If aid from business met their needs for increased operating income, the privately supported colleges and universities would be given a decisive lift in performing successfully their part in our system of higher education. They would still have large needs of capital equipment — buildings, dormitories, laboratories — but help from other sources, such as that provided by devoted alumni, where they are well organized, could be expected to go far toward meeting these needs. Also some companies prefer to concentrate on meeting needs of this type.

What 1% of Profits Would Do

But do business firms have the capacity to fill the gap in adequate operating income for our privately endowed colleges and universities without putting an excessive financial burden on themselves? Those who have studied this capacity carefully say that the answer clearly is yes. If, of its profits before taxes — last year an estimated $43 billion — business were to devote 1% to helping our privately endowed colleges, it would take care of present operating needs of about $350 million a year. And the balance of $80 million would be a big step in meeting their needs for new buildings and equipment, too.

About one half of a 1% contribution of this sort would, in effect, be made by the federal government. Up to a limit of 5%, contributions of this type are exempt from the federal corporate income tax. For corporations with incomes above $25,000 per year this tax is 52%.

It is clear that not all business firms are in shape to devote 1% of their profits to aid to higher education. Even in this year of record-breaking prosperity, many of them will have no profits at all. But if business generally would take 1% of pre-tax profits as a target or benchmark for financial help to our privately endowed colleges and universities these institutions would again have sturdy financial foundations.

Relatively this is a very small price to pay (1) to insure a continuing supply of competently trained young men and women and (2) to buttress our freedom by assuring the successful survival of the privately supported sector of our system of higher education.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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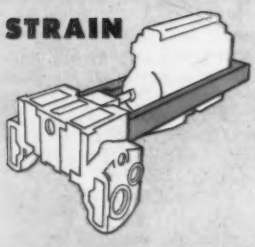
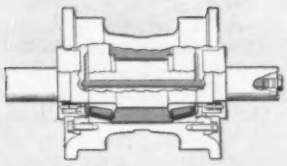


Frame-twisting stresses prove the value of the Allis-Chalmers all-steel, Box-A Main Frame. It is strong and flexible . . . soaks up strains. It is a complete unit . . . does *not* use the engine as a structural member. It allows more efficient equipment mounting, provides excellent weight distribution and makes possible unit construction for unmatched servicing ease.

THE SHOCK

Sudden overloads are common in dozer operations. But hydraulic torque converter drive cushions the shock and protects the entire power train. This drive is standard equipment on the HD-21 and has been *proved* on Allis-Chalmers tractors since 1941.

THE GRIND



Sometimes tracks churn all day in fine, abrasive stone . . . could be a serious threat to final drives, idlers, truck wheels and support roller bearings. But this "grinding compound" never reaches the bearings on an Allis-Chalmers tractor. Exclusive design features make it possible to use tapered roller bearings with *Positive* Seals that keep dirt and moisture out and hold lubrication in for at least 1,000 hours.

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WASHINGTON IMPACT

Highlights

YOU CAN STILL GET FAST TAX WRITEOFFS on new production facilities—plants and equipment—for many metals, and minerals, despite the fact that Washington recently turned down with much fanfare the steel industry's request for new capacity expansion goals, and simultaneously closed down titanium and taconite iron ore goals.

HERE'S WHAT—All the fuss about market-tight steel was because its secret production capacity goal had been reached. The goals are still open for the following metals: chemical grade chromite, battery and chemical grade manganese, mercury, nickel, selenium and substitutes for strategic mica. Also, production of hafnium, zirconium, boron, and many other so-called atomic minerals is eligible for fast tax amortization under such "hidden" goals as those for research and development, and defense procurement.

HERE'S WHY—The key to Administration policy on fast tax writeoffs is simply this: If any producer can show that production from a new plant or added facilities is needed by the military, over and above the capacity on which tax amortization already has been approved, he's in. Steel couldn't convince defense mobilization director Arthur Flemming and Cabinet strong-man Treasury Secretary George Humphrey, so it didn't get its capacity goals boosted. Washington will turn a deaf ear to pleas about a tight civilian market. It thinks the fast tax writeoff laws, a wartime measure, are legally meant to take care of only the defense establishment, under full-scale mobilization requirements. What really clinched the decision not to boost goals generally was a letter from the Pentagon, saying its full mobilization requirements estimates will be lower in the future than in the past.

HERE'S HOW—If you think you qualify for fast amortization on a new plant or facility, you file an application with ODM. Flemming's office then checks with the Pentagon, AEC and Commerce Department to get their thoughts on the over-all supply of whatever it is you plan to produce, and how much the nation would need in wartime. If you pass this test, you get to write off anywhere from 40-65% of your capital outlay against income over five years, instead of the usual 20, depending on the nature of the facilities, plus another 5% if you qualify as a small business.

BARTER IS BACK IN THE NEWS. It has been increasing at a significant rate, and Washington officials see it as good way to unload surplus agricultural stocks and at the same time acquire strategic materials to the Government's advantage. Administration has been answering industry skepticism over the program by assuring that it will help to siphon off foreign surpluses, thus upholding world prices, and also assuring that the acquired stockpile stocks will be frozen off the market. It is a keystone of Eisenhower's over-all minerals policy program (see budget story, this page).

Lead and zinc people still have reservations. A group of producers met with White House economic adviser Gabriel Hauge last month to express their hopes for a long-range program for domestic (rather than foreign) lead and zinc to supplant Government support purchases when run out. William Dawson (R-Utah), speaking for the producers, said he is convinced the barter program stimulates too much competitive foreign production.

There is some talk in Washington about expanding the barter program to allow acquisition of domestic metals such as lead, zinc and copper in exchange for crop surpluses. This would be practically possible since all barter is handled through brokers, who sometimes sell the crops abroad before they return foreign ores to the U. S. stockpile. But such a liberalization would raise serious legal questions about the intent of the barter laws, which provide for only exchange of U. S. crops for foreign ores. Congress is a good bet to look into the broker practices in this area, whether or not any change in the rules is proposed.

More Research Aid Seen In Eisenhower Message

THE PRESIDENT'S BUDGET for fiscal 1958, started July 1, 1957, reflects Administration trends in its attitude toward the domestic mining industries which come as no surprise. In a nutshell, the formula is—less money for stockpiling and price support purchase programs, more for research and development and other technical aid.

On stockpiling and defense production, the President had this to say:

"By the end of the current fiscal year, the stockpile of strategic and critical materials, such as rubber, aluminum, copper, and nickel, will have reached a value greater than $6-billion. Further acquisitions toward the stockpile objectives will be limited in most instances to (1) materials for which contracts have already been made; (2) materials which can be procured at favorable prices and which will serve to maintain the mobilization base; and (3) materials obtained in exchange for surplus agricultural products."

And, on mineral resources:

"The Secretary of the Interior is developing a minerals program to meet the long-range needs of the nation, now that the defense minerals programs are nearing completion. In th meantime, a program authorized in the past session of the Congress will provide $91-million of assistance to segments of the mining industry in adjusting from defense needs to normal market conditions.

Here are the actual budget figures applicable to the metal and mineral mining industries:

Gross expenditures for developing mineral resources—$104-million, a $10-million boost over the estimates for fiscal 1957 and almost two and a half times the $43-million actually spent in fiscal 1956.

General Services Administration money for buying metals and minerals—$345-million in fiscal 1958, down from $433-million estimated in fiscal 1957. Interior Department funds for acquisition of strategic minerals—$13-million, down from the $17-million estimated for the current fiscal year.

Late Developments

INTERIOR DEPARTMENT has eased specifications on domestic fluorspar bought by General Services Administration under the stop-gap support purchase program authorized by Congress last summer.

Domestic acid-grade fluorspar producers complained to Interior that the maximum tolerance of 0.03% free of sulphide sulphur allowed in shipments approved was too low. They agreed that a higher sulphur content would not make the product unusable. The pro-

ducers apparently won their argument.

Under the new specifications, GSA will accept shipments with the following requirements: a minimum of 97% CaF_2, maximum of 1.1% SiO_2, and a maximum of 0.1% sulphur. The change is expected to meet producers' objections to the previous specifications.

A NEW REPORT ON TITANIUM made by the Senate Interior committee praises the metal's progress and criticises the administration's handling of domestic production incentives. The second such report in just over a year, the Senate committee study called for (1) cost study aimed at lowering primary production costs, (2) co-ordination among Government agencies dealing with the titanium program, and (3) exchange of know-how among users of the metal.

Surveying research institutions, the military establishment, and 67 companies, the committee found that ODM has closed down its capacity expansion tax incentive program at about 22,500 tons of sponge, or 30,000 tons of ingot. The metal, which the Air Force is primarily interested in as a high-temperature alloy for jet aircraft and missiles, is still "in scarce supply."

Production last year ran around 12,000 tons, the Committee found—probably enough to meet existing military needs. But the Committee said the Air Force had recommended a safety margin of supply of 100% over current needs.

NICKEL SUPPLY AND DISTRIBUTION, which has been a hot subject on Capitol Hill ever since the current market shortage began, came in for more review last month. The joint Senate-House defense production committee questioned "suppliers aggregate ability to achieve a distribution pattern for the entire industry that could be termed equitable and fair."

Committee said the military has found it needs more nickel alloy to replace aluminum and titanium in jet aircraft, because experiments with these metals have not proved as successful as some had hoped. The report criticized the Government for being unable to release nickel in a fixed pattern. But the committee predicted a "moderate" increase in non-defense nickel supplies this year.

Another report, from the Department of Commerce to Congress, also criticized suppliers' distribution patterns, but described International Nickel Co., the nation's major supplier, as being "eminently fair" in meeting its customers' needs. The Department also blamed a lack of free market prices as contributing to small users' (such as electroplaters) shortages. Commerce, however, said civilian allocation controls are unnecessary, although predicting that supply-demand scales won't balance out for another five years until current production incentive programs start to take effect.

Labor This Month

LABOR RACKETEERING PROBE LOOMS: The long-threatened exposure of corruption in labor unions will break wide open this year. Touched lightly in Congressional racketeering hearings two years ago and followed up in welfare fund investigations last year, the subject will now get the full treatment. Preliminary penetrations by Congressional investigators show a cross-country racketeering chain among union officials—and this is just the beginning. Congress has authorized $250-million for a closer look, and before it's over, the subject will hit the headlines.

While union corruption shows signs of being much more extensive than had been suspected, it still doesn't touch a majority of the labor movement. Only about a dozen unions are involved out of some 250, and none are the giant industrial unions. Corrupt union leaders are being uncovered in industries broken up into small companies—trucking, garment, construction and the like. Small employers are prey to bribery, extortion and other illegal rackets—and frequently are found to be in collusion with union officials. The type of evidence that's being uncovered includes rifling of union treasuries by its officers; agreement between union leader and employer to withhold contract demands—for a payoff; pacts between employer associations and a union to withhold labor service from "outside" firms.

THE CLEAN-UP—WHERE IT WILL COME: The Capitol Hill investigations will go on through th remainder of the year, and probably well into 1958. At the same time, within the Government and the labor movement itself, pressures will be at work to wipe out the racketeering as it is exposed in Congress. Investigators foresee hearings rivalling the Kefauver crime hearings of a few years ago when local, state and Federal authorities cracked down as soon as the details broke before the public. There's a two-point program behind Congress that will be working at the same time.

- In the Department of Justice, racketeering squads will be doing their own investigating, picking up tips that come out of the hearings and prosecuting individual union leaders. But, the Departmnet will also be drawng up new, and tougher, legislation to handle union racketeering. The two current laws, Taft-Hartley and the Hobbs Act, are considered inadequate to check corrupt unions. Once the hearings are done, Congress will be asked to pass amendments that will put the necessary teeth into the anti-racketeering laws.
- Organized labor, through the AFL-CIO, will attempt a house-cleaning of its affiliated unions discovered to be corrupt. The machinery for such a clean-up is already churning; the AFL-CIO ethical practices committee has called three small unions on the carpet on evidence supplied by the Congressional welfare fund probes of last year. The final penalty may be suspension of these unions from the federation. In addition, two officers of AFL-CIO locals have been suspended from their posts during a follow-up investigation of alleged mis-use of union money.

While exposures hurt labor's reputation, AFL-CIO leaders welcome it as the one method that aids their own house-cleaning programs. Federation leaders lack the legal authority of Congress to penetrate corrupt union pockets, but they can use the evidence it unfolds to follow-up.

NON-FERROUS LABOR CONTRACTS—A COSTLY ITEM: Final returns on 1956 labor-management contracts in the non-ferrous metals industry are in. They outrank, by far, the costs of the agreements of the year before and are even slightly ahead of the average of all agreements. Three-fourths of labor agreements averaged out at 10 to 12c an hour in wages. Fringe settlements were also extensive, with insurance leading the way. Other popular 1956 contract items in non-ferrous agreements were deferred increases over the three-year contract span, pensions and cost-of-living clauses.

This compares with the overall 1956 average wage hike of 10.3c. The year before, this average was 7.9c.

P&H Electric Shovels

Illustrated is a P&H 1600—6 cu. yd. Electric Shovel. This is the third P&H Electric Shovel purchased by Dewey Portland Cement Company and one of six P&H machines used at their Davenport plant.

Rotary Kilns

FOR FUEL ECONOMY, KENNEDY KILNS CAN BE SUPPLIED WITH

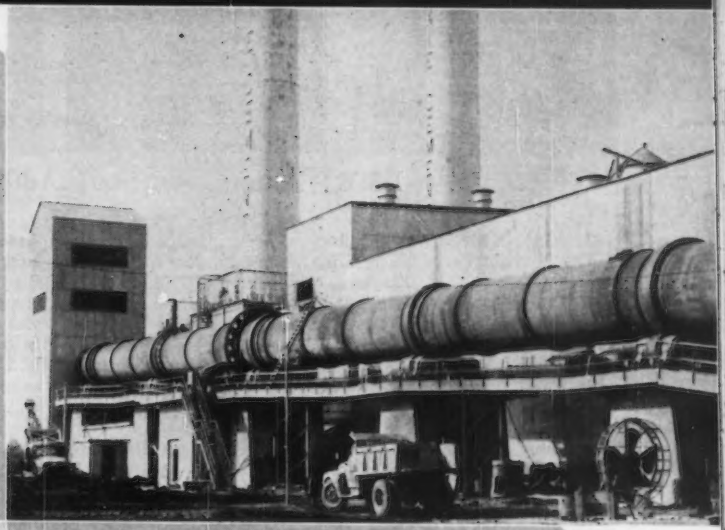
nedy Multivane Internal Recuperator

or

ennedy-Grudex External Preheater

or

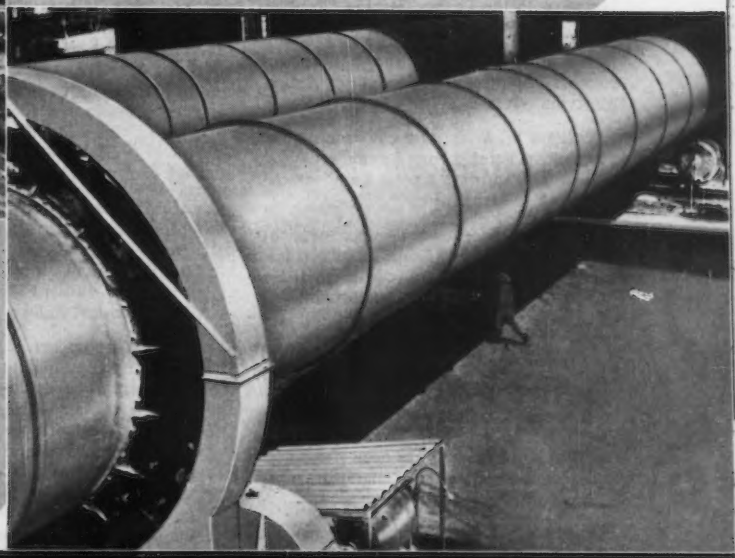
nnedy External Stone Preheater



Kennedy, 11'x375' Rotary Kiln in Wet Process Plant.

Two, 11'x375' Kennedy Rotary Kilns in process of erection at 5,000 Barrels per day. Wet process Cement Plant.

Two, 10'x175' Kennedy Rotary Kilns, in Dry Process Cement Plant.



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PERSONALS

E&MJ Announces Staff Addition and Promotions

DONALD C. McGRAW JR. (left) has been appointed advertising sales manager of *Engineering & Mining Journal, E&MJ Metal & Mineral Markets* and *Coal Age*. Joining McGraw-Hill Publishing Co. in August 1950, Mr. McGraw has been advertising salesman in the Atlantic District and associate manager of the Eastern district. Prior to his appointment to the mining papers, he was assistant director of advertising sales for the company. **Daniel P. Eigo,** news editor, **Lloyd E. Antonides,** assistant editor and **James W. Franklin,** assistant editor, have been promoted to associate editors of *E&MJ*. Mr. Eigo joined *E&MJ* in August 1953 as copy editor and was named news editor in January 1955. Mr. Franklin joined the staff in April 1955 and Mr. Antonides in January 1955. Mr. Eigo and Mr. Franklin co-authored the article "Lithium" (*E&MJ*, September 1955) which won a merit award for editorial achievement in the annual Jesse H. Neal competition.

Anthony Mastrovich has been appointed general manager of operations for Climax Uranium Co., with headquarters in Grand Junction, Colo. He joined the firm in 1952 as assistant mine superintendent and advanced to assistant general manager in 1954. Mr. Mastrovich, a graduate of South Dakota School of Mines, succeeds the late **Marvin I. Kay,** vice president and general manager.

Mark Lintz, mining and metallurgical engineer of San Francisco, is in the state of Jalisco, Mexico, on mine examination work.

Eildon C. Ferreira, geologist with U. S. Steel's Oliver Iron Mining Division, has recently moved to Montreal, Canada and is now with the Cartier Mining Co., Ltd.

Robert H. Jacobson, assistant comptroller of the Copper Range Co., was elected comptroller succeeding **Robert McArthur,** retired.

William W. Widstrand has been named assistant general plant foreman of the Hull-Rust iron mine crushing and screening plant, Mesabi Range.

Douglas Joyce, general superintendent of the Algoma Steel Corp., has been advanced to manager of operations. He joined Algoma in 1949 as superintendent of blast furnaces.

Ralph B. Hurd, formerly with the Charleson Iron Mining Co.'s Charleson plant at Virginia, Minn., has recently been named superintendent of the Coons Pacific Concentrator at Eveleth, succeeding **Don Kimball** who has been promoted to assistant to the general manager, metallurgy, of Pacific Isle Mining Co.

J. William Bryant, controller and assistant treasurer, has been named a vice president of Reserve Mining Co., and will assume the duties of **C. L. Kingsbury.** Mr. Kingsbury has resigned as vice president but will continue in a consulting capacity to Armco Steel Corp.

Robert W. Hughes, vice president and general manager of Miami Copper Co., has resigned because of reasons of health. He has been with Miami Copper for over 32 years. **Benjamin R. Coil,** formerly manager, has been named general manager, succeeding Mr. Hughes. **J. H. Gray,** general superintendent, has been named assistant general manager. **C. C. Webb,** chief designing engineer, has been named general superintendent succeeding Mr. Gray. **R. P. Hughes,** master mechanic, Copper Cities Division, has replaced Mr. Webb as chief designing engineer.

Lyman A. Bliss has been named president of Union Carbide Nuclear Co., a division of Union Carbide & Carbon Corp., succeeding **Kenneth Rush,** vice president of Union Carbide & Carbon, who will continue to have over-all responsibility for the corporation's nuclear and international activities. Mr. Bliss joined Union Carbide in 1922. He was named vice president of Union Carbide Nuclear in 1955.

Enoch Perkins, a leading authority on chrome ore, has been elected a director of Wm. H. Muller & Co., Inc., Mr. Perkins, until his recent retirement, was associated with the Mutual Chemical Division of Allied Chemical & Dye Corp.

Lithium Corporation of America has announced the appointment of two senior vice presidents to newly created positions, and four new vice presidents. Named senior vice presidents were: **Willis W. Osborne,** vice president and treasurer; and **Fremont F. Clarke,** vice president and general manager of operations. Named vice presidents were: **Dr. R. B. Ellestad,** director of research; **Walter M. Fenton,** director of product research and development; **J. Dean Herman,** director of chemical plant operations, and **J. D. Campbell,** director of sales.

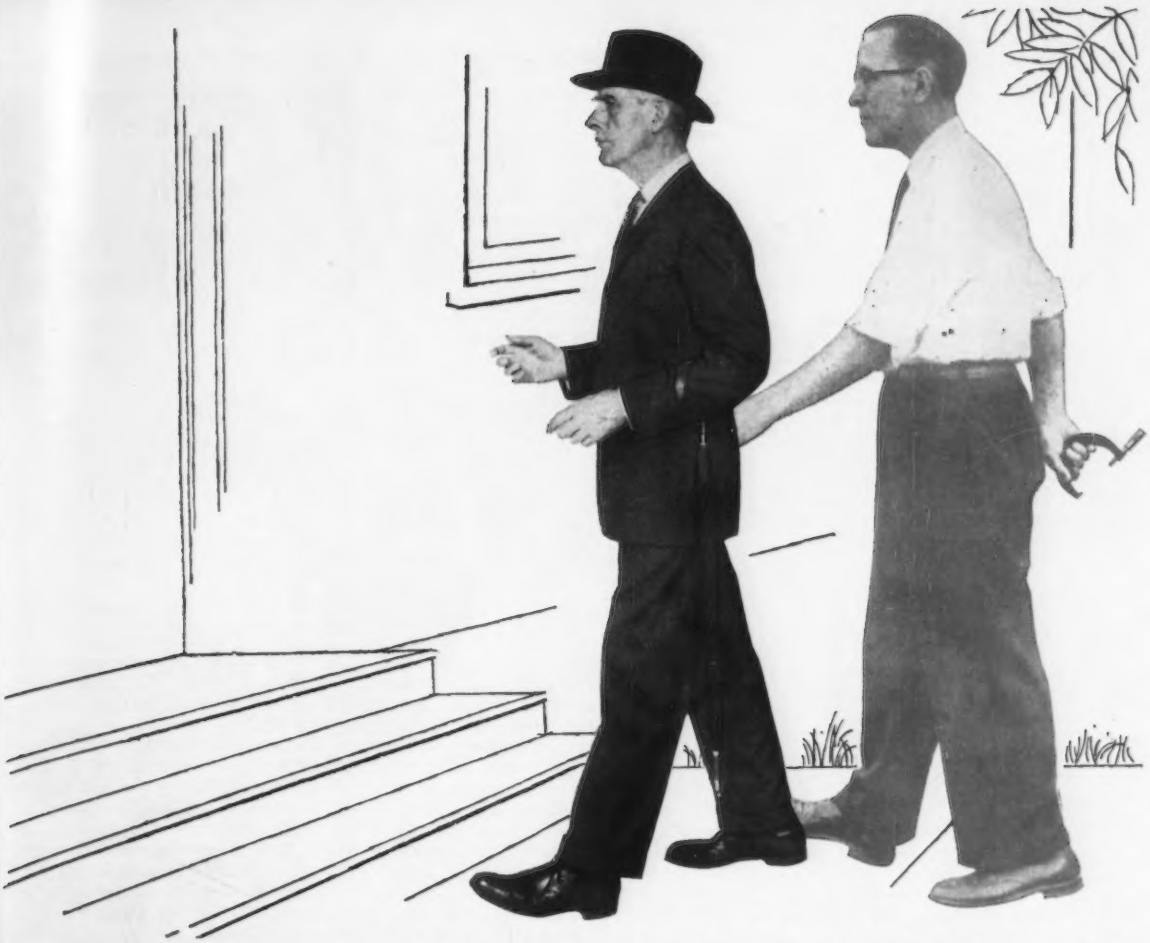
Ralph E. Magnuson Jr., has been promoted to chief mining engineer for the Cleveland-Cliffs Iron Co. on the Michigan Ranges. **Daniel Isaacson** has been named district mining engineer to assist Mr. Magnuson. Mr. Magnuson joined Cleveland-Cliffs in 1946 and was named administrative assistant in 1954. Mr. Isaacson joined the company in 1940 and was made mine engineer in 1952.

S. E. Quayle has retired as manager of Michigan district mines, M. A. Hanna Co., after 39 years of service with the company. **W. F. Shinners** has been named to succeed Mr. Quayle. Other changes announced by the company include the appointment of **Kurt E. Kuehlthau** as general superintendent of underground mines in the Michigan district and **J. D. McAuliffe** as superintendent of the Homer and Wauseca mines; and **Jack Morrow** who has been chief mining engineer in the Michigan district was named operating engineer of those two mines. **Richard Peterson** has been named to succeed Mr. Morrow.

Herbert A. Wendel has been appointed chairman of the bureau of safety of the Anaconda Co., succeeding **John L. Boardman** who retired after 33 years of service with the company.

Rollin J. Kennard, chief engineer of mechanical and electrical departments of the Anaconda Co. Western properties since 1950, has retired. He is succeeded by **Carl J. Lundborg,** mechanical superintendent of the Anaconda Aluminum Co., at Columbia Falls, Mont. Mr. Kennard joined Anaconda in 1914 as assistant electrical superintendent at the smelter in Anaconda. Mr. Lundborg joined the company in 1926.

Earle E. Steinbrecher has been named assistant general plant foreman at the Sherman iron mine crushing and screening plant of Oliver Iron Mining division.



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PERSONALS (*Continued*)

Dufour

Wilson

FREEPORT Sulphur Co. has announced the election of **Maurice F. Dufour** and **Forbes K. Wilson** as vice presidents. Mr. Dufour joined Freeport in 1933 and is in charge of the company's nickel and cobalt interests. Mr. Wilson joined the company in 1942 and is manager of mineral exploration. Both men are also vice presidents of Nicaro Nickel Co., a subsidiary of Freeport Sulphur Co. in Moa Bay, Cuba.

W. E. Mitchell, manager of the Anaconda Reduction Works, Anaconda, Mont., since 1941, has retired, and is succeeded by **W. A. Emanuel,** general superintendent of the plant. Mr. Mitchell has served Anaconda for 45 years and will continue his affiliation with the company as a metallurgical consultant. Mr. Emanuel joined Anaconda as assistant engineer in the testing department in 1920.

Reinhold Schempp has been named manager of Sanderson-Halcomb Works, Syracuse, N. Y., and **S. A. Fronek,** manager of the Park Works, Pittsburgh, Pa., of the Crucible Steel Co. of America. Mr. Schempp succeeds **R. A. Schneid,** and Mr. Fronek succeeds **S. A. Jackson,** both retired.

Morris V. Mielke has been named assistant general superintendent at Oliver Iron Mining Division's Eastern district operations. He joined Oliver in 1948 and was made superintendent of Oliver's Extaca agglomeration taconite plant at Virginia, Minn., in 1952.

James N. Hinyard has been appointed director of market development for American Potash & Chemical Corp., succeeding **Dr. A. J. Dirksen,** recently named general sales manager of the company's Industrial Chemicals Division.

George W. Mitchell, general manager of the Eureka Corp., Ltd., has announced his resignation. He came to Eureka from Bishop, Calif., in 1944 and was appointed superintendent of operations at the Ruby Hill mines. He was later appointed general manager by T. L. Lindsay, president of Ventures Inc., of Toronto.

American Potash & Chemical Corp. has announced several changes at its main plant at Trona, Calif. **Myron W. Colony,** former chief engineer, has assumed responsibilities of advisory engineer; **James Jensen,** former assistant chief engineer, has been named manager of plant engineering; **Howard Barker,** former plant engineering head, has been named assistant manager of plant engineering. **W. C. Henderson,** former general foreman of maintenance and construction, was named plant engineer, and **A. L. Cartter,** foreman of maintenance and construction, has succeeded Mr. Henderson.

Dr. Maurice Cook, F.I.M., joint managing director, Imperial Chemical Industries, Ltd., Metals Division, has been awarded the Institute of Metals (platinum) Medal for 1957, for outstanding contribution to the science of metallurgy, to the non-ferrous metals industry and to the welfare of the metallurgical profession. **Dr. H. K. Hardy,** A.R.S.M., A.I.M., research manager, United Kingdom Atomic Energy Authority, has been awarded the Rosenbain Medal for 1957 in recognition of his outstanding contributions to knowledge in the field of physical metallurgy.

Nevada Mining Association has elected the following officers for 1957: **John C. Kinnear Jr.,** general manager, Kennecott Copper Corp., Nevada Mines Division, honorary president; **F. A. McGonigle,** vice president, Manganese, Inc., president; **Charles H. Segerstrom Jr.,** president, Nevada-Massachusetts Co., first vice president; **Roy A. Hardy,** consulting engineer, Getchell Mine, Inc., second vice president; and **Louis D. Gordon,** executive secretary. The following directors were elected: Mr. Hardy; **Ray M. Henricksen,** consulting engineer, Nevada Scheelite Corp.; Mr. Kinnear; **John C. McDonald,** resident manager, United States Lime Products Corp.; Mr. McGonigle; **A. E. Millar,** general manager, Anaconda Co., Yerington Mine; **A. J. O'Connor,** vice president and general manager, Consolidated Coppermines Corp.; Mr. Segerstrom; and **J. J. Strutzel Jr.,** vice president and general manager, Wah Chang Mining Corp.

Jesse C. Johnson, director, Division of Raw Materials, Atomic Energy Commission, has been named to receive the distinguished service award.

H. S. Newhall, former senior development engineer, Engineering & Construction Department of Electro Metallurgical Co., has been promoted to chief development engineer.

Jewitt

Morris

CONSOLIDATED Mining & Smelting Co. has appointed **W. G. Jewitt,** assistant general manager since 1952, to the position of vice president in charge of mines. **D. D. Morris,** assistant general manager since 1955, has been named to succeed Mr. Jewitt as assistant general manager.

Thompson

Callaghan

NEW MEXICO State Bureau of Mines and Mineral Resources has appointed **Alvin J. Thompson** director succeeding **Dr. Eugene Callaghan.** Mr. Thompson is head of the department of mining and metallurgy at New Mexico Institute of Mining and Technology in Socorro. Dr. Callaghan has joined Haile Mines Corp. of New York as chief geologist in charge of explorations, with headquarters in Salt Lake City.

Three senior mines appointments have been made by Consolidated Mining & Smelting Co. **B. E. Hurdle** has been appointed assistant manager of mines. In his new post, Mr. Hurdle will be located at Trail and will be responsible for all of Cominco's producing mines. **J. R. Gieger-ich** succeeds him as general superintendent of the company's operations at Kimberley. **R. J. Armstrong** has been named assistant to the vice president in charge of mines. Also announced was the appointment of **Richard Deane** as chief electrical engineer.

C. E. Bronson has joined the Cassiar Asbestos Corp., Ltd., Cassiar, B. C., as plant superintendent. He had formerly been in the engineering and surveying business in Jackson, Calif.

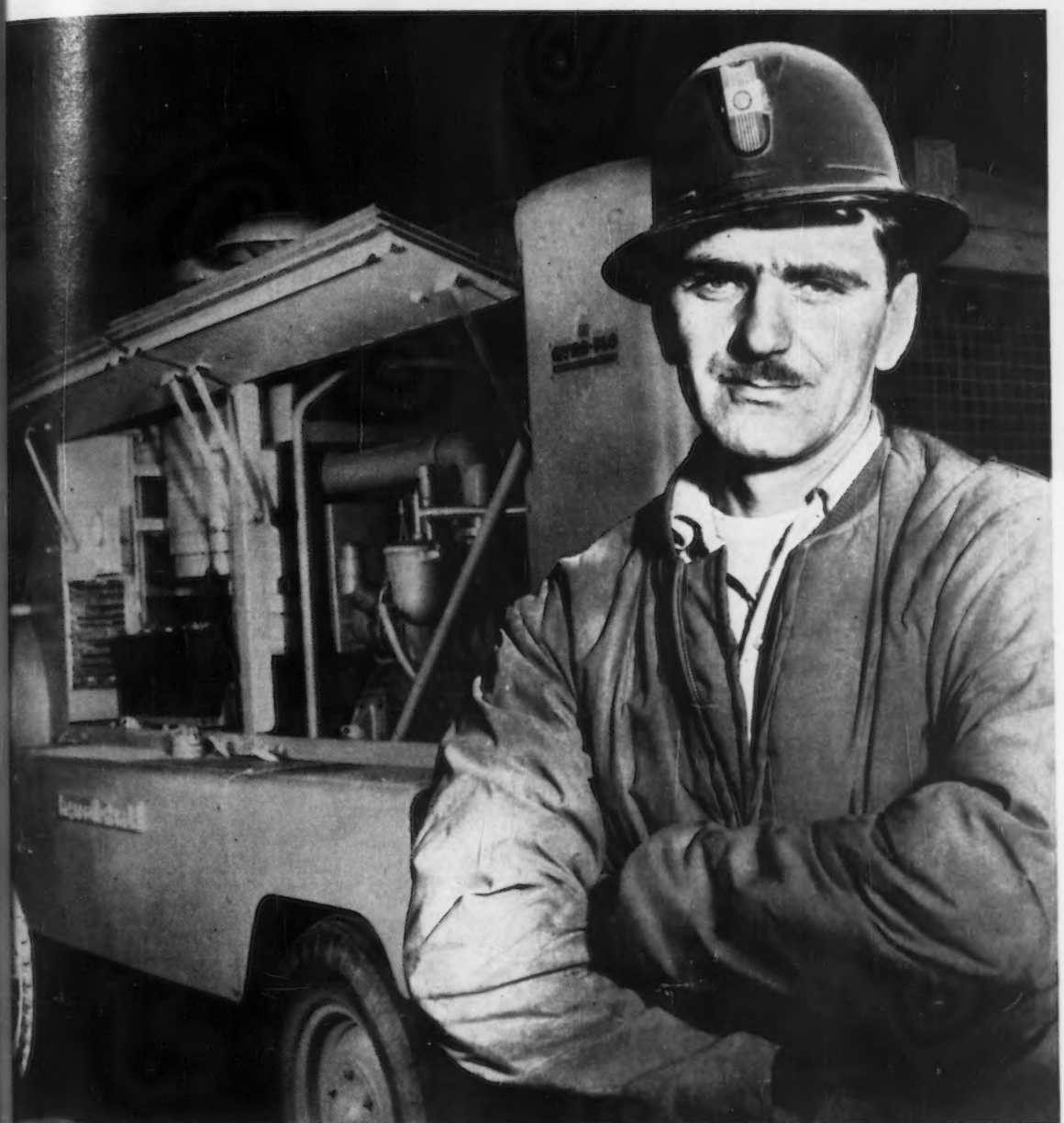
Henry G. Schuring, formerly mill superintendent of the Atlas Consolidated Mining & Development Corp., Cebu, Philippines, is now manager of the purchasing department for the same firm.

L. C. Jones, chief engineer of Utah Copper Division of Kennecott Copper Corp., has retired following service with the firm dating back to 1908.

Jackson How has been appointed director of public relations for American Smelting & Refining Co. He was vice president of John Mather Lupton Co., Inc., advertising agency and had been account supervisor for American Smelting & Refining Co. since 1954.

Walter J. Longnecker has been appointed manager of operations in the Cleveland district for American Steel & Wire division.

Clifford J. Sheehan, eastern sales manager, Die Casting Division of Aluminum Company of America, Garwood, N. J., has been named president of the American Die Casting Institute, succeeding **W. J. During,** resigned.



Ned Fillip, Benton Division, Wah Chang Mining Corp., Bishop, California

"T5X licked the carbon problem here"

"Until we started using T5X Motor Oil in our diesel-powered compressors we experienced a great deal of trouble with stuck rings and clogged up ports due to formation of hard carbon deposits.

"T5X licked this carbon problem for us here and has substantially reduced our maintenance costs and down time."

As Mr. Fillip has found, T5X is ideally suited for heavy duty diesel lubrication. If carbon is a problem with your diesel equipment we suggest you ask your nearby Union Oil representative for *amazing* T5X Motor Oil.

UNION OIL COMPANY 76
OF CALIFORNIA

Los Angeles: Union Oil Bldg. • New York: 45 Rockefeller Plaza • Chicago: 1612 Bankers Bldg. • Philadelphia: Eastwick Ave. & Edgewood St. Dallas: 313 Fidelity Union Life Bldg. • Kansas City, Mo.: 612 W. 47th St. New Orleans: 644 Nat'l Bank of Commerce Bldg. • Boston: 214 Harvard Ave.

PERSONALS (*Continued*)

American Institute of Mining, Metallurgical, and Petroleum Engineers has announced that its first award of the recently established Robert Lansing Hardy Gold Medal is to **Dr. Douglas W. Fuerstenau,** research engineer in the mineral and chemical engineering group, metal research laboratories of Electro Metallurgical Co. Dr. Fuerstenau joined the company last June and is a section leader specializing in mineral dressing.

Fuerstenau

Stanley M. Lane, assistant general superintendent of the American Smelting and Refining Co.'s plant located in East Helena, Montana, has been appointed the new chairman of the Montana Section of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Other officers elected are as follows: **Edward P. Shea,** Butte, vice chairman; **Clifford J. Hicks,** Butte, secretary-treasurer for a sixth consecutive term; **George Hanson,** Columbia Falls, **J. J. Dougherty,** Anaconda, and **John Warren,** Butte, executive committee; **Fred W. Strandberg,** of Butte, **Clifford Milkwick,** Anaconda, and **Joseph T. Roy,** of East Helena, elected to the nominating committee. Mr. Lane fills the vacancy created by the sudden death of **Clarence V. Saylor** of Great Falls, Mont.

University of Minnesota has named **Dr. Charles Fairhurst,** Ph.D. 1955 from Sheffield University in England, to the staff of the Department of Mineral Engineering at the School of Mines and Metallurgy. Dr. Fairhurst did both his undergraduate and graduate work at the University of Sheffield. His principal research interest is in drilling of rocks and he was recently awarded the Sam Mavor Students Prize from the Institution of Mining Engineers of London for his paper "Some Possibilities and Limitations of Rotary Drilling in Hard Rocks." Dr. Fairhurst is presenting the courses in mine plant engineering at the Minnesota School of Mines, and at the same time carrying on his research work in the field of rotary-percussive drilling of hard rocks.

Fairhurst

William T. Pettijohn has been appointed assistant to the vice president in charge of mining and exploration for the New Jersey Zinc Co., with headquarters at New York. He started his employment with the company in 1948 and was made assistant superintendent in 1951. He served as superintendent of the Hanover, N. M., mine from 1952 until 1954 when he was transferred to New York to become assistant to the manager of exploration.

B. F. Mahoney of Stibnite, Idaho, has been named assistant manager of employee relations at Kellogg, Idaho, for the Bunker Hill Co. Mr. Mahoney had been employed as manager of the Bradley Mining Co.'s Yellow Pine mine and antimony smelter at Stibnite. He will be succeeded as manager by **Arnold S. Souders.** Both men are graduates of University of Idaho.

John H. Melvin, state geologist of Ohio since 1947, has been elected vice president of operations for the Pennsylvania Drilling Co., of Pittsburgh.

R. W. Bryden has taken a position as mechanical and electrical superintendent with Tsumeb Mines Corp., South West Africa. Mr. Bryden formerly had his own consultant practice.

J. R. LeGrand of Erwin, Tenn., has been appointed production manager of the Consolidated Feldspar Department of Industrial Minerals Division of International Minerals & Chemical Corp. He has been superintendent of the company's mica plant for the past year.

Professor E. O. Lilge, department of mining and metallurgy of the University of Alberta, Edmonta, Alta., has been appointed president of the Alberta and Northwest Chamber of Mines for 1957. He succeeds **J. C. Dale,** general manager of Canadian Utilities Ltd., Edmonton.

Allan Sproul, former president of the Federal Reserve Bank of New York, has been elected to the board of directors of Kaiser Aluminum & Chemical Corp. of Oakland, Calif. Mr. Sproul headed the New York bank for 15 years, retiring in 1956. He is a graduate of the University of California.

Robert O. Jones, manager of the western division of Standard Slag Co. at Gabbs, Nev., has returned from an extended trip through Japan where he examined mines and mining operations, and visited steel plants and refractory producers near Kokyo, Kobe, Fukuoko and Muroran. Present acting plant superintendent at the Standard Slag Co. mill is **W. C. Burnett,** who is replacing **S. V. Wines.** Mr. Wines, former plant superintendent at Gabbs, has been transferred to Los Angeles where Standard Slag has acquired a glass plant. **S. W. Reinmiller** is superintendent of mining operations, and exploration work is under direction of **E. L. Stevenson,** consulting geophysicist, of Reno.

R. F. Petit, formerly a member of the faculty of the Missouri School of Mines and Metallurgy, is now chief engineer for American Smelting & Refining Co. at Wallace, Idaho.

Richard Harker, mining engineer, Anaconda Co., is now with Jones & Laughlin Steel Corp.

The Bunker Hill Co. has appointed **Harold E. Lee** as vice president in charge of research and development. He has been manager of metallurgy for the past year. Mr. Lee joined the company in 1931, and as manager of metallurgy, he has been responsible for the company's reduction plants, which include concentrating mills, the lead smelter and the electrolytic zinc plant. He has also been in charge of ore procurement and he will continue this responsibility in his new post.

Lee

Frank P. Knight, mining engineer of Tucson, Ariz., has been appointed acting director of the Arizona Department of Mineral Resources, succeeding **Roger I. C. Manning,** department director since 1951, who died Dec. 8, 1956. A graduate of Massachusetts Institute of Technology in 1923, Mr. Knight has been active in Arizona mine operations since 1937 when he took over the management of the Christmas Copper Corp. He has served as president of the company since 1953.

John R. Post, former St. Louis district manager of Commercial Solvents Corp., has been elected president and general manager of Out West Uranium & Oil Co., succeeding **Richard K. Baker,** resigned. Mr. Post is a graduate of Missouri School of Mines & Metallurgy at Rolla.

Battelle Memorial Institute, Columbus, Ohio, has appointed **Dr. B. D. Thomas** as the Institute's new director, succeeding **Dr. Clyde Williams,** president of the Institute. A member of the executive and technical staff since 1934, Dr. Thomas was appointed assistant director in 1942. Subsequently, he was named secretary, and in July 1955, he became vice president. He is a member of the American Institute of Mining and Metallurgical Engineers.

Thomas

Murray K. Pickard has been named general manager, and **Kenneth C. Grogan** mine manager of Giant Yellowknife Gold Mines, Ltd. at its Northwest Territories mine. Mr. Pickard, formerly chief engineer and assistant mine superintendent, succeeds **P. N. Pitcher** who resigned. Mr. Grogan was formerly treatment plant superintendent.

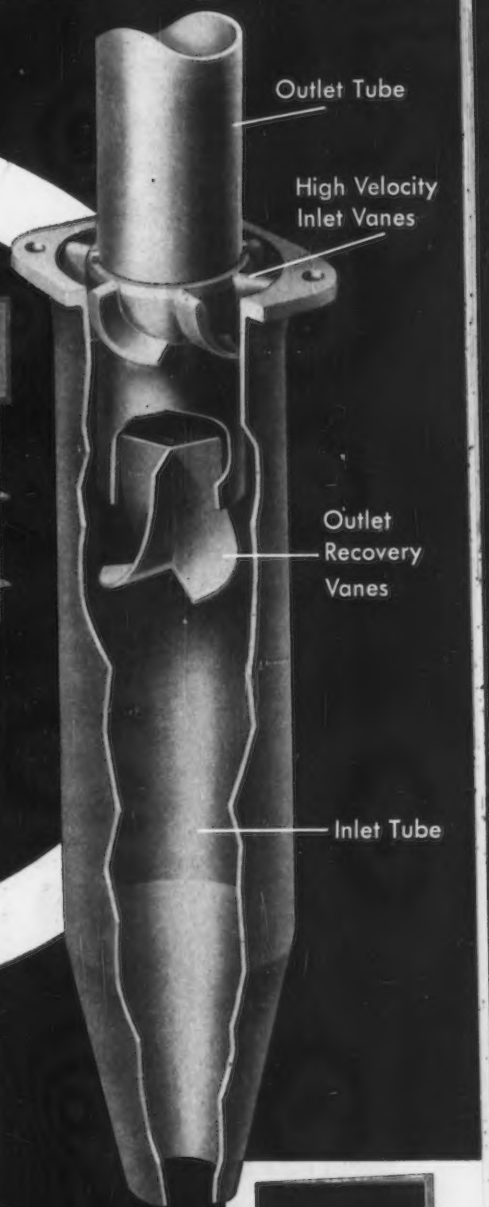
W. Ralph Salter has been named president and **Mark G. Smerchanski** executive vice president of Beattie-DuQuesne Mines; Mr. Smerchanski has been named president of New Manitoba Gold Mines; and Oka Rare Metals Mining Co. has

NEW Cyclo-trell

multiple tube dust collector

Here are a few brief facts on Research's new multiple tube mechanical collector.

- Collection efficiencies are higher, for a given pressure drop, than other conventional multiple tube collectors.
- Gas flow per tube is higher than conventional units. This means fewer tubes per collector and lower total cost for a given capacity.
- Cyclo-trell's design is based on Research's 45 years experience in manufacturing gas cleaning equipment. As the largest manufacturer of electrical precipitators in the world, Research-Cottrell has engineered and built many combination units consisting of precipitators and mechanical collectors.



Higher Collection Efficiency

An important reason for Cyclo-trell's higher collection efficiency is the aerodynamically shaped inlet vane unit. The purpose of these vanes is to produce a fast spiral of incoming gas. The faster these gases spin, the greater the centrifugal force on the suspended dust.

After testing many types and curvatures of vanes, Research found that this new design resulted in less turbulence, greater centrifugal force and higher collection efficiencies.

Greater Gas Handling Capacity

To develop a higher gas flow capacity than other multiple tube collectors, Research's engineers developed the following design features. First, by using a 10" diameter inlet tube, instead of the conventional 9" tube, the flow of incoming gas was increased.

The next step was to straighten the gas flow as it entered the outlet tube, since a spiraling gas stream creates more resistance than a straight through flow. In the Cyclo-trell this spiral is eliminated, and energy is recovered, in the outlet tube by the Outlet Recovery Vanes. By positioning these vanes below the tube, rather than inside, resistance has been further reduced.

This combination of features means greater gas flow per tube, fewer tubes per collector and a lower total cost for a given capacity and efficiency.

Bulletin M gives complete details on design features, efficiency, capacity and detailed dimensional drawings. Write for your copy today.

Research-Cottrell, Inc.

Main Office and Plant: Bound Brook, N. J. • 405 Lexington Ave., New York 17, N.Y. • Grant Bldg., Pittsburgh 19, Pa. • 228 N. La Salle St., Chicago 1, Ill. • 111 Sutter Bldg., San Francisco 4, Cal.

PERSONALS *(Continued)*

named Mr. Salter president and Mr. Smerchanski executive vice president. The changes were occasioned by the recent death of **C. Glenn Hunter,** president of all three firms.

James G. LeSieur Jr. has been appointed director of the organization and personnel division of the Grand Junction Operations Office of the Atomic Energy Commission. A veteran of 23 years in Federal personnel service, Mr. LeSieur has been at Oak Ridge, Tenn., for the past 13 years as chief of the Government personnel branch.

Thomas J. Hubbard has been appointed superintendent, Magna Plant, Kennecott's Utah Copper Division, succeeding **John Allan,** retired.

Utah Mining Association held its 39th annual meeting, electing officers for 1957. **Clark L. Wilson,** vice president of New Park Mining Co., was elected president of the association. **Charles A. Steen,** president of Utex exploration Co., Inc., was elected first vice president and **Oscar A. Glaeser,** vice president and general manager, western operations of United States Smelting, Refining and Mining Co. was elected second vice president. **A. G. Mackenzie,** former manager of the association, was sustained as vice president and consultant; **Miles P. Romney,** secretary-manager, and **Walter M. Horne,** assistant secretary-manager, were sustained in their present positions. The following members were elected as new members of the board of directors: **G. W. DeLaMare,** United Park City Mines Co.; **J. W. Losse Jr.,** Uranium Reduction Co.; **C. D. Michaelson,** Kennecott Copper Corp.; **Paul Gemmill,** Combined **Metals Reduction** Co.; and **S. K. Droubay,** International Smelting and Refining Co.

Wilson

Steen

Glaeser

James W. Hutchison has been named vice president in charge of reduction at Olin Revere Metals Corp. He has been plant manager of the Jones Mill Reduction Plant of Reynolds Metals Co.

Neil B. Little has joined the Gaddis Mining Co. of Denver as landman. He was formerly with Shell Oil in Casper, Billings and Denver, and recently has been an independent operating in Colorado and Utah.

Hjalmar Backlund, captain of the Armour No. 1 iron mine, Cuyuna Range, operated by the Inland Steel Co., retired Nov. 1. He has been on the Cuyuna Range since the range started in 1910, with the Roger-Brown Ore Co., at the Kennedy Mine.

OBITUARIES

Dr. Victor DeMunck, 36, geologist for Kaiser Aluminum & Chemical Corp., was killed Dec. 12 in an airplane crash in Costa Rica, where he was engaged in a bauxite exploration project. Prior to joining Kaiser, Dr. DeMunck was affiliated with the Montana Bureau of Mines and Geology, in Butte, and authored articles on lightweight aggregates in the Great Falls area and with iron ore deposits in Montana.

Merton L. Signer, 56, dean of faculty at Colorado School of Mines since 1947, died Nov. 17 following a heart attack, at Golden, Colo. Dean Signer joined the faculty as instructor in 1929, and was mining department head before he became dean of faculty. He had been chairman of the Colorado State Planning Commission since 1950.

Woodrow Knott, 43, manager of the Climax Uranium plant at Grand Junction, Colo., died at his desk Nov. 7, following a heart attack. He had been with Climax for six years.

Prof. Albert E. White, 82, director of the University of Michigan's engineering research institute from 1920 to 1953, died Dec. 18 at St. Joseph's Mercy Hospital, Ann Arbor, Mich. Professor White was instrumental in founding the American Society of Metals and served as its first president. He also was former president of the American Society for Testing Materials.

J. O. Elton, 77, mining engineer and retired general manager of International Smelting & Refining Co., Salt Lake City, died Dec. 1 en route from his home in New Port Rickey, Fla., to Tampa.

Clarence V. Saylor, general superintendent of the Great Falls, Mont., reduction department of the Anaconda Co., died Dec. 15 while in Butte attending the annual meeting of the Montana Section of the AIME. Mr. Saylor had been with the Anaconda Co. for more than 30 years.

Roger I. C. Manning, 57, director of the Arizona Department of Minerals and Resources, died Dec. 8, following a heart attack suffered while on a quail hunting trip. A graduate of the Rolla School of Mines in Missouri, he went to Arizona in 1930. He served three years there with the Bureau of Mines, returned to Missouri, then went back to Arizona in 1945.

Max W. Dessau, 54, official for Climax Molybdenum Co., died Dec. 12 at his Golden, Colo., home following a heart attack. He had been head mill superintendent at the firm's mines at Climax, Colo., until last September when he was transferred to the research laboratory at Golden. A graduate from Colorado School of Mines in 1920, Mr. Dessau worked for Climax from 1935 to 1937 when he went to Bolivia to work for the Patino Mines and the Companie Mineral de Minas. He returned to Climax in 1942.

Letters *(Continued from p 4)*

deposit was first discovered by a resident of the area and its potential value first recognized by a Brazilian engineer, Dr. Velasco. Dr. Marais visited the area for a brief period in the latter part of 1955 and reported significant volume of zinc, lead and copper ore."

It is unfortunate that this paragraph was not included in the press release for it would have saved embarrassment when we found that USGS geologists had been credited in the press, either directly or by implication, with discovery of the Vazante deposit.

W. D. Johnston Jr.
Chief, Foreign Geology Branch
U. S. Geological Survey
Washington 25, D. C.

Drill Holes Collect Water

Dear Sir:

In reading the December issue of *Engineering & Mining Journal,* I note with interest the letter "New Sources of Water," written by Mr. William Crocker of Prescott, Ariz., and would like to comment on same.

The complex geologic structure and the comparatively recent uplift of the mountain region of the State of Arizona have resulted in a rugged terrain that has restricted farm development in this region. The rock types, predominantly granite, gneiss, and schist, absorb little water. Combined with the high altitude and steep slope, results in the development of large quantities of runoff. The mountain region is the principal source of surface water for irrigating the desert region of the state.

In some areas, diamond drilling small diameter holes horizontally, crosscutting the cracks and seams that carry the store water, has produced sufficient water to meet the requirements of livestock, thus sparing the expense of pumping.

Small bore diamond drill holes drilled vertically in selected areas are producing good water for domestic use.

E. P. Fletcher
Western Drilling
411 N. Central Ave.
Phoenix, Ariz.

NEW U.S. PATENTS

OLIVER S. NORTH

Copies of U. S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Blasting of Rock Bodies. R. B. Aitchison and J. J. Calaman (assigned to Union Carbide & Carbon Corp., a corporation of N. Y.). 12-4-56. 2,772,632.

Method of blasting orebodies containing large quantities of boulders, such as are encountered in the taconite fields. Normal blasting often simply moves instead of breaking these boulders, necessitating costly and hazardous secondary reduction practices. Primary and satellite blast holes are drilled. Maximum fragmentation results when charges in secondary holes are detonated with a time lag up to about 50 milliseconds after shooting primary hole.

Seismic Exploration. E. Merten (assigned to Shell Development Co., New York, N. Y.). 12-4-56. 2,772,775.

Apparatus for controlling surface-detonated seismic prospecting charges. Motorized equipment is fitted with a bridge or truss member carrying at rear a large diameter bell, or hemisphere. Explosive gas charge is introduced beneath the bell through a valve-closed conduit, and ignited. Air noise is substantially reduced, and little if any cavity is formed in the ground.

Treatment of Sylvinite Ore. G. E. Atwood (assigned to International Minerals & Chemical Corp., a corporation of N. Y.). 12-4-56. 2,772,775.

Sylvinite ore is comminuted by heating it to a temperature above 180 degrees C but below fusion. Ore decrepitates, liberating the constituent minerals, sylvite and halite, with minimum production of fines.

Apparatus and Method for Separating Fines. T. L. Myron (assigned to United States Steel Corp., a corporation of N. J.). 12-4-56. 2,772,776.

Method and apparatus for separating fines from wet granular ores, for example, iron ores being charged to blast furnaces. Material is fed to a series of conveyor belts arranged in tandem and moving rapidly. Particles tend to stratify according to size. A layer of fines clings to belt as it starts its return movement, whereas coarser particles are projected further out and are picked up on next belt in series. An additional portion of fines is removed on each successive belt, until the material reaches desired gradation.

Magnetic Separation of Ores. A. L. J. Queneau. 12-4-56. 2,772,777.

Multiple separator having a series of magnetic fields of increasing intensity is used for separating mineral values from ore pulps in which values with varying degrees of magnetic susceptibility are found, such as mixtures of magnetite with hematite or limonite.

Processing Disseminated Chrome Ores. A. M. Thomsen (assigned to American Chrome Co., a corporation of Nev.). 12-4-56. 2,772,957.

Process for recovering chromium from low grade or disseminated chrome or chrome-nickel ores or tailings, along with silica and magnesium sulphate as by-products. Complex silicates of the groundmass are decomposed and removed by reacting ground ore with a limited amount of sulphuric acid or ammonium bisulphate, and drying, dissolving and classifying the resulting material. Chromite sludge and a magnesium sulphate-solids product are obtained.

Indurating Process. D. Beggs and E. R. Johnson (assigned to Erie Mining Co., Hibbing, Minn.). 12-4-56. 2,772,958.

Process for indurating pellets of moist finely divided mineral solids, for example, iron or other ore fines or concentrates, phosphate rock fines and the like, in a shaft furnace. Surfaces of raw pellets are brought to a temperature equaling dew point of the exit gases before being added to the stockline. A column of ascending, temperature-controlled, heated gas moves countercurrent to direction of pellet movement.

Electric Furnace Smelting of Silicate Ores. L. J. Lichty and R. T. C. Rasmussen (assigned to Quebec Metallurgical Industries Ltd., Ottawa, Ontario, Canada). 12-4-56. 2,772,959.

Smelting low-grade, non-sulphide nickel or nickel-cobalt ores in an electric arc furnace, using a carbonaceous reducing agent. High grade ferronickel or ferrocobalt can be thus produced.

Smelting Method. C. A. Seger and P. B. Dettmer (assigned to Quebec Metallurgical Industries Ltd., Ottawa, Ontario, Canada). 12-4-56. 2,772,961.

Smelting hydroxides, oxides, or carbonates of nickel or cobalt, especially compounds of those metals derived by precipitation from an aqueous solution, with or without subsequent calcining. Fines are briquetted with a standard roll press and smelted in a conventional furnace. Carbonaceous reducing agent is added to molten bath to reduce metallic compound to metal.

Gravel and Sand Washer and Concentrator. C. C. Tyer. 12-11-56. 2,773,594.

A mechanism of simple construction and unique motion for use in economically recovering placer gold from low grade deposits. In the apparatus, clay is disintegrated under water and the heavy materials settle into entrapment areas. Clean sand and gravel, suitable for use as concrete aggregate, can be recovered as by-products.

Placing Seismic Explosive Charges. J. Norman Jr., and A. B. Hamil. 12-11-56. 2,773,669.

Apparatus and method for placing subsurface seismic explosive charges in sandy or mushy soil. Charge is carried adjacent to drill bit, and connected by ignition cable with a spool fixed in the pipe, during drilling. When the point of blasting is reached, the casing is disconnected from bit and pulled. Spool unwinds as pipe is withdrawn, leaving bit and charge in the hole. Explosive can be detonated successfully even though hole wall is collapsed around ignition cable.

Treatment of Phosphate Rock to Recover Phosphorus, Fluorine, Calcium, and Uranium. C. A. Hollingsworth (assigned to Smith-Douglass Co., Inc., Norfolk, Va.). 12-11-56. 2,773,736.

Ground phosphate rock is heated with a reducing agent, for example coal, in a chlorine-containing environment. Fluorine and phosphorus are volatilized and recovered. Calcium forms calcium chloride, and any uranium present is converted to a uranyl chloride, both recoverable from the aluminous-siliceous residue.

Chemical Processes for Recovering Columbium Values From Niobiferous Ferrophosphorus. M. L. Nielsen and L. K. Duncan (assigned to Monsanto Chemical Co., St. Louis, Mo.). 12-11-56. 2,773,737.

Improved process for recovering columbium values from phosphatic ores, such as those found in Africa. Ore is roasted, and columbium containing ferrophosphorus product is mixed with soda ash and sintered. Sinter is crushed and leached with hot water, and residue thereof leached with cold dilute hydrochloric acid, fused with potassium pyrosulfate, and dissolved in hot tartaric acid. Columbium content is recovered as Cb_2O_5 by digesting the columbium tartrate complex with hot concentrated hydrochloric acid.

Method of Obtaining Sodium Bicarbonate. W. J. Burkholder (assigned to Diamond Alkali Co., Cleveland, Ohio). 12-11-56. 2,773,739.

Process for obtaining high-quality crystalline sodium bicarbonate by contacting crude natural salt brine with an optimum quantity of CO_2 under carefully controlled temperature and pressure.

Tower Agitation System. J. C. Pirtle. 12-11-56. 2,773,749.

Process for treating various types of ores, especially manganese oxide ores, to recover the metal. Ground manganese oxide ore is treated with sulphur dioxide gas in agitation towers charged with water. Pulp is filtered, and manganese-containing solution evaporated in a conventional mechanism.

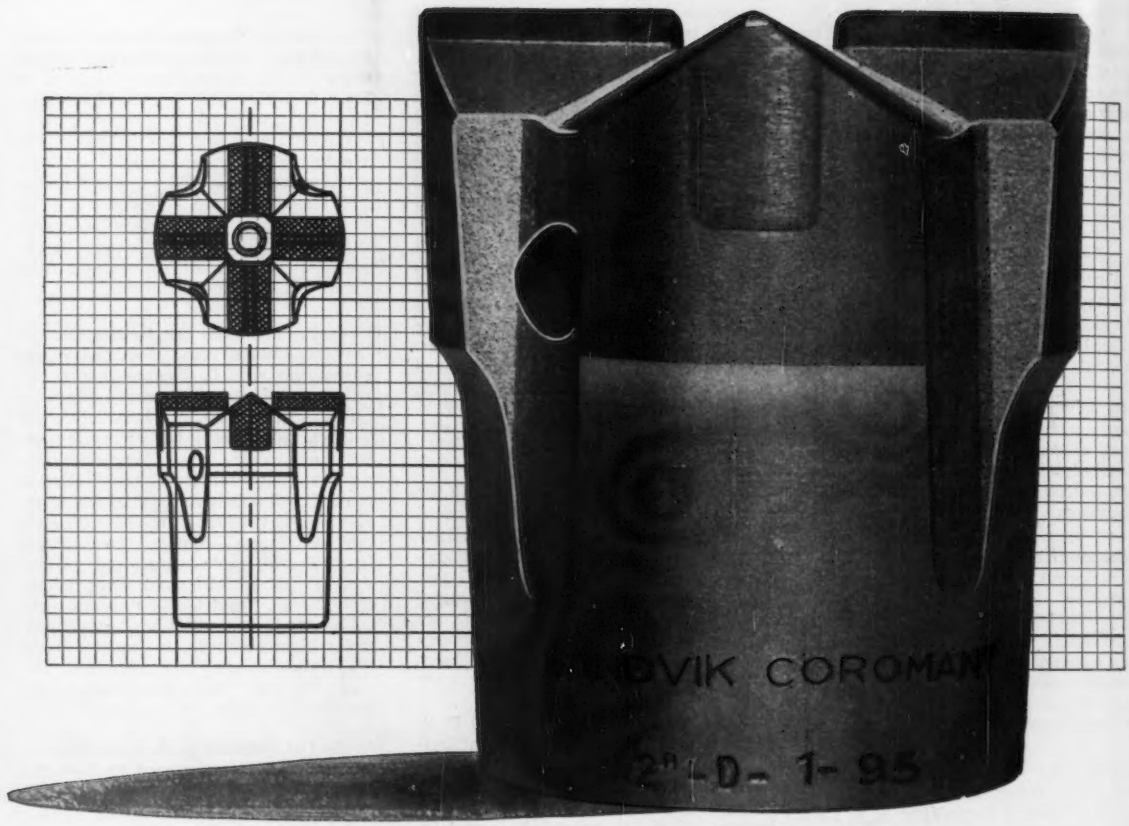
Electrolytic Process of Salvaging Uranium. R. Q. Boyer and S. B. Kilner (assigned to U. S. Atomic Energy Commission). 12-11-56. 2,773,820.

Improved electrolytic process for recovering uranium from wash solutions derived from calutrons.

(Continued on p 278)

Mr. North is patent consultant, Washington, D. C.

THIS ROCK BIT IS PRECISION-MADE FOR A HIGHER PERFORMANCE



Nothing tougher and more wear-resistant than the insert of a Sandvik Coromant 776 bit

Rock bits that go on *and on* must have highest-grade tungsten-carbide inserts. Nothing but tungsten carbide in its purest state is good enough, will last as long. That's why the carbide that goes into a Sandvik Coromant 776 bit is meticulously controlled.

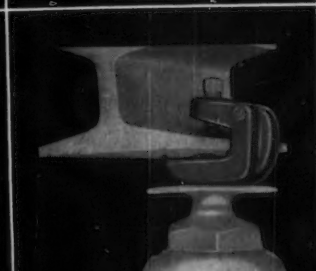
Sandvik, the world's largest manufacturers of brazed-in tungsten-carbide inserts for rock drilling, control every phase of production. Coromant carbide is scrutinized for impurities from the very first stages of processing the tungsten ore, right through to the final inserts. Add to that Sandvik's special process of securing the insert to the body, employing an exceptionally strong bonding metal, and you know why a Coromant 776 bit lasts longer. In 1955, one billion feet were drilled with these inserts, all fitted to Sandvik Coromant bits or integral steels. *Nothing is more conclusive of the quality of Coromant bits than this figure.*

2. Trolley Frogs, Crossovers

3. Expansion Bolts

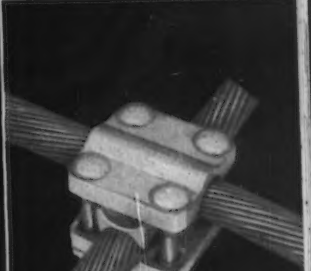
4. Automatic Couplers

6. Trolley Wire Clamps



7. Hanger Adapters

8. Insulated Hangers



9. Branch Connectors

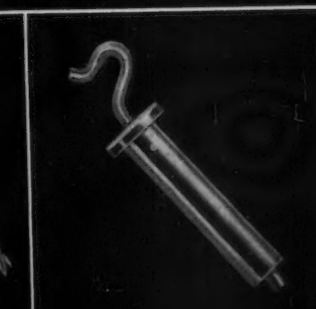
11. Trolley Wire Conditioning Equipment

12. Wheel Collectors

13. Feeder and Trolley Splicers

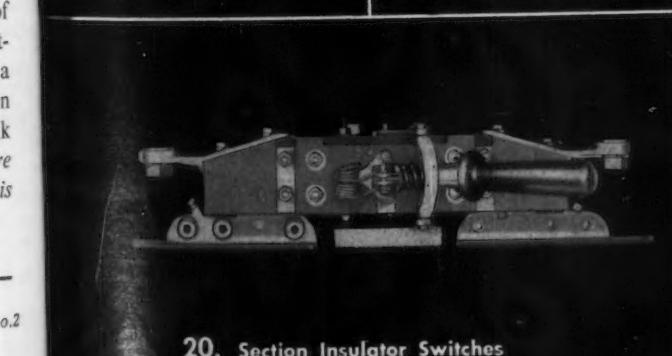
14. Quick Break Switches

16. Shoe Collectors



17. Fused Taps

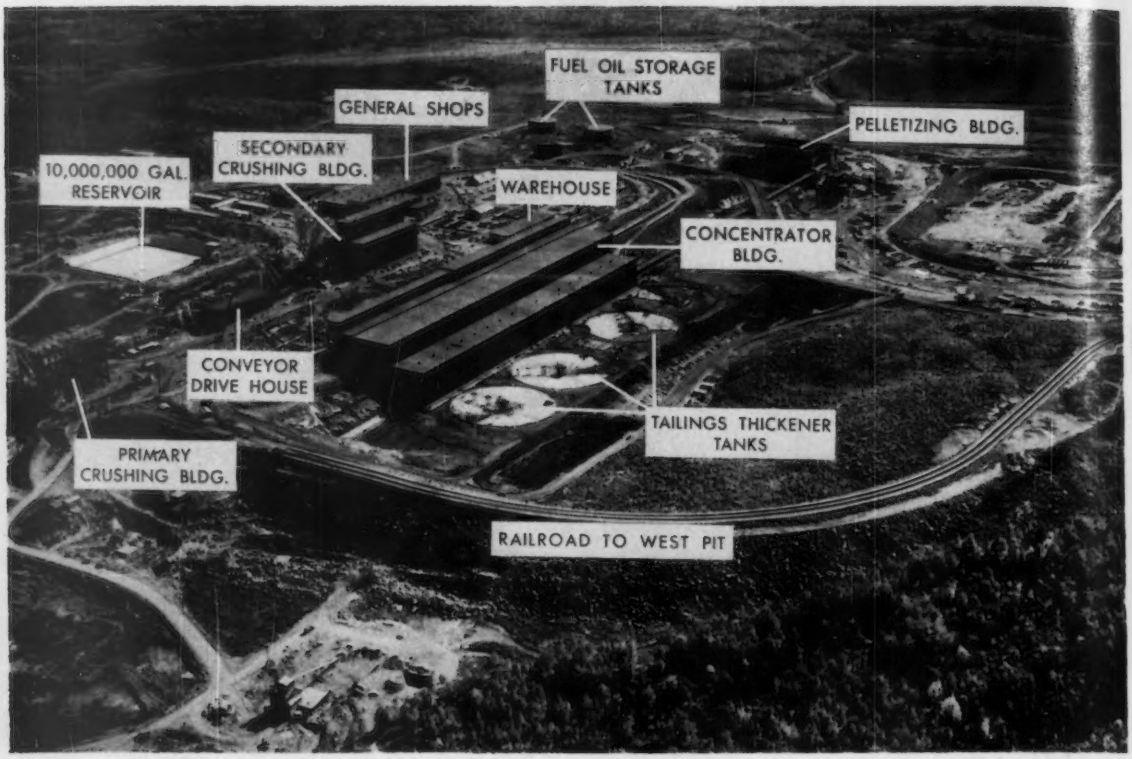
18. Rail Bonds



20. Section Insulator Switches

21. Combination Feeder Trolley Clamps

22. Bond Welding Equipment



TACONITE PLANT of Erie Mining Co. is located at the mine site. Railroad will haul pellets to the harbor. Trains will average 100 cars of 85 tons each and will hit speeds of 60 mph loaded and 65 mph when empty.

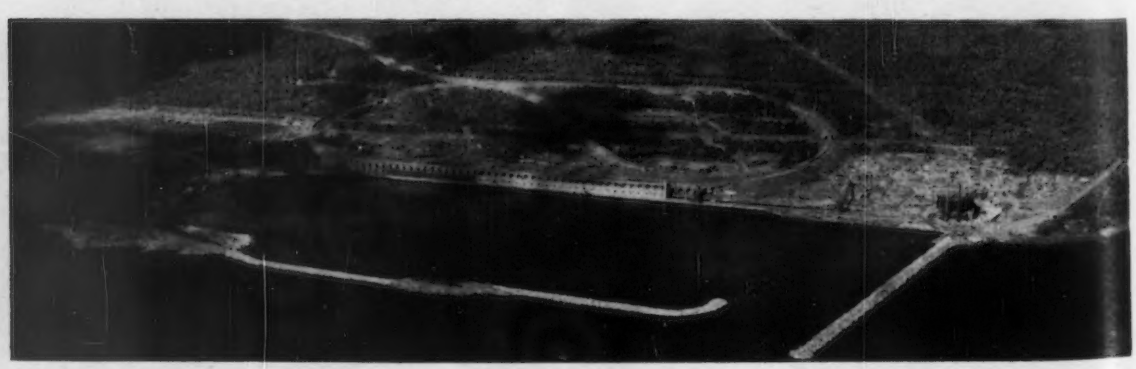
Erie Taconite Nears Completion

SPENDING an average of a quarter of a million dollars a day since construction began early in 1954, Erie Mining Co., has completed more than 70% of the work required to put its Lake Superior taconite project on stream. When mine, railroad, plant and harbor swing into production at the end of 1957, over $300-million will have been spent on the operation that will produce 7.5-million tons of taconite pellets a year.

(Unlike Reserve Mining's taconite project [*E&MJ*, December 1956], Erie has built its concentrator and pelletizing plant at the mine site. Reserve built these plants at their Silver Bay harbor site where all the water in Lake Superior is available for processing the taconite.)

Mining facilities are just about ready. Pre-production stripping was completed last May. Power lines have been strung and mine rails are being laid. Most buildings and structures are complete.

In full operation, the mine will use a battery of jet piercing machines for blast hole drilling, but other drills are being tested. Ore will be loaded by electric



TACONITE HARBOR, at the other end of the company's 73-mile railroad line, required man-made breakwaters to protect ships. Facilities will load two ore boats at once, and storage is provided for 100,000 tons of pellets.

Euclid tractors and scrapers

lower stripping costs for mines and quarries

Tremendous power, speed and maneuverability make the 436 h.p. Euclid TC-12 Twin-Power Crawler a top performer in heavy duty mine and quarry work. No other tractor matches it for low cost production in stripping overburden, clearing, stockpiling, building haul roads and other big tractor jobs.

Euclid scrapers have struck capacities from 7 to 24 cu. yds. with engines ranging from 143 to 518 h.p. The complete line, including both two axle and three axle models, has hydraulic lever action that eliminates down-time caused by cable breakage. Good maneuverability and fast travel speed reduce cycle time . . . help move more loads and more yards for lower cost stripping operations.

Check the many advantages of "Eucs" for your operation . . . have a Euclid dealer show you why ***Euclids are your best investment.***

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EUCLID DIVISION, GENERAL MOTORS CORP., Cleveland 17, Ohio

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE

THIS MONTH IN MINING *(Continued)*

MINING FACILITIES are just about ready. Blast holes will be put down by jet piercing. Ore will be loaded by electric shovels, hauled by diesel-electric loco.

CONCENTRATOR has 25 to 27 rod mills in place, and 24 of 27 ball mills. Plant will produce enough concentrates to make 7.5-million tons of pellets a year.

LOADING DOCK is 1200 ft long. Traveling belt conveyors will move the pellets by positive feed from the storage bin and deliver them directly to the ships' holds.

shovels and hauled by diesel-electric locomotives to the primary crushing plant in trains made up of 90-ton side dump cars.

At the plant, structural steel for the primary crusher building was up by late summer and the roofing and siding have been installed. In the concentrator, 25 of 27 rod mills were in place and 24 of 27 ball mills.

Walling and roofing of the pelletizing plant are about complete, with work continuing on furnace brickwork, piping, heating and ventilating systems. A 10-million gal reservoir for the concentrator plant is complete, as is the sewage treatment plant.

Railroad construction is practically done, though final track alignment will wait for next spring. The railroad is 73 miles long with 16 of those miles cut through muskeg swamps. About 10 miles from the harbor, the track runs through an 1800-ft tunnel cut through solid granite. Typical trains will be made up of 100 cars each containing 85 long tons of taconite pellets. The 1750-hp diesel locomotives will hit 60 mph with loaded trains, 65 mph unloaded.

Taconite Harbor, 75 miles north of Duluth, was finished in December. As the year ended, contractors were testing conveyors for ore and coal, electrical equipment and other machinery.

The ore dock is 1200 ft long and will store up to 100,000 tons of pellets. Traveling belt conveyors will move the pellets by positive feed from the storage bin, delivering them directly to the ships' holds. Dock facilities are designed to load two ore boats at once.

The new town of Hoyt Lakes, named for Elton Hoyt 2nd, former senior partner of Pickands Mather & Co., went onto the maps in February 1955 when its post office was opened. A September census showed a population of 1,030. By the end of 1958, when 1,200 houses should be completed, population is expected to rise to about 4,500.

In 1957, installation of machinery, electrical and power equipment, piping, plumbing and other interior work will be wound up. Finishing touches will be put to harbor, railroad and mine. Production should start by the year's end.

Erie's History. In 1931, realizing that the Mesabi ranges reserves of direct shipping ore must eventually be exhausted, Pickands Mather & Co. began to look for alternative sources. Although containing only 30% iron, compared to 50% for direct shipping ores, the taconite reserves were so huge they won the decision.

Erie Mining Co. was formed in 1940. By 1953 working plans for the taconite project were finalized and construction began in 1954. Present owners of Erie are Bethlehem Steel, Youngstown Sheet & Tube, Interlake Iron and the Steel Company of Canada.

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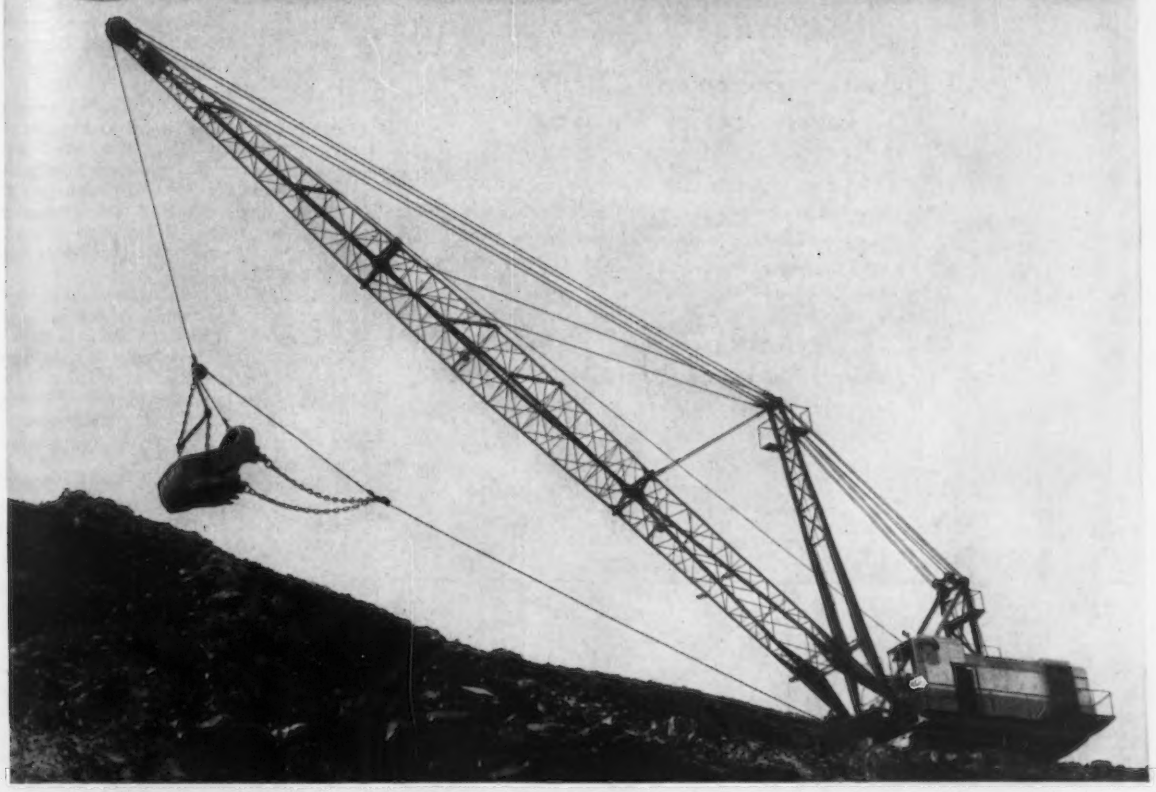
American Cable TRU-LAY VHS | 15% STRONGER



57% Longer Life with New VHS Dragline

Draglines take a real beating in the coal stripping operations of the C B & M Coal Company, Plains, Pennsylvania. Used for removing over-burden, the best Improved Plow Steel draglines lasted 525 hours. When new TRU-LAY VHS draglines were used they established service records of 825 hours—57% better than Improved Plow Steel.

Entirely New Grade

Mines all over the country are setting similar service records with new VHS. Made from a new grade of steel for wire rope—New VHS is at least 15% stronger than Improved Plow Steel, the strongest grade available before VHS. This means you can handle heavier loads with the same diameter line. And you get a higher factor of safety.

For Slusher Ropes, Shovel Hoist Ropes, Draglines

New VHS is also tougher . . . resists abrasion . . . cannot become "hide-bound" or lose its flexibility. Developed especially for use as slusher ropes, draglines and shovel hoist ropes, it stands up better in these toughest services.

Cuts "Down Time"—Saves Money

In addition to longer life, new VHS cuts costly "down time" of equipment for wire rope replacement. This can mean real savings.

At Your Distributor Now

Your American Cable distributor has draglines, slusher ropes and shovel hoist ropes of new VHS in stock now. Just call him and tell him the size and length you want. You don't need any complicated specifications.

See your American Cable Distributor or write to the nearest American Chain & Cable Company Office

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out of the factory into the ground . .

and a champion every foot of the way

J. K. Smit Diamond Drill Bits are designed and engineered in our own plant, and manufactured with one purpose in mind: to give you maximum cutting speed, plus the most economical footage under any possible hole conditions.

Problem	Solution
Non-abrasive formations	HARDHED matrix
Average drilling conditions	HARDHED 40 matrix
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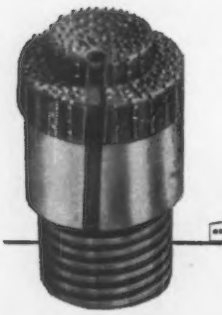

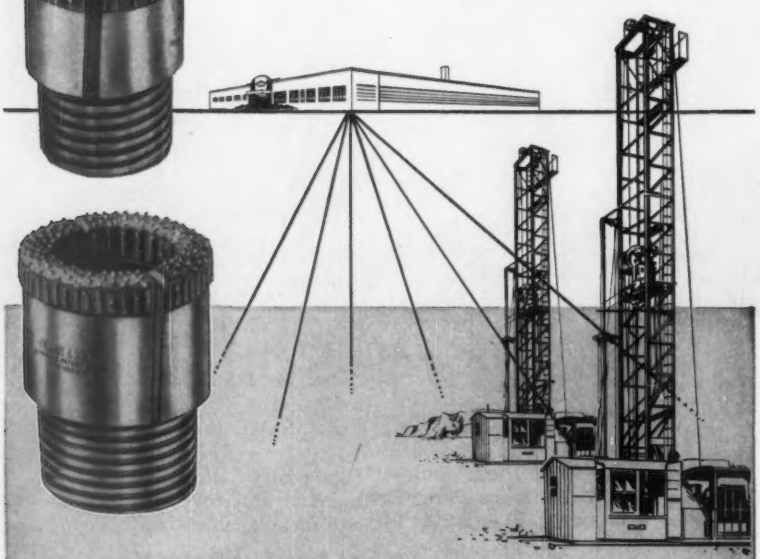

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Vitro Corp. Joins Firm To Produce Manganese

FORMATION of a new company to produce manganese from domestic ores, and award of a GSA contract to pilot a process for such production was announced by J. Carlton Ward Jr., president of Vitro Corporation of America.

Joining in announcement were Philip H. Sellew, president of Sheer-Korman Associates, Inc., and Albert M. Garbade, president of Great Divide Mining & Milling Corp.

GSA contract, extending 19 months and totaling $270,541, was awarded to Vitro Laboratories Division, which will equip, operate and maintain pilot plant in its West Orange, N.J., laboratory to develop process for full scale production using the Sheer-Korman high intensity arc process on rhodonite (see *E&MJ* July 1954, p 98).

Rhodonite is a highly refractory, manganese-rich ore which exists in large quantities in Colorado. Prior to Sheer-Korman process, rhodonite has not been suitable for economic exploitation. Laboratory tests indicate treatment of rhodonite with the arc makes ore amenable to manganese recovery by conventional methods.

New company, U.S. Manganese Corp., recently incorporated in Delaware, is owned 40% by Vitro; 40% by Sheer-Korman, which has supplied its processes and patents; and 20% by Great Divide, whose deposits will supply the rhodonite ore.

Officers of U.S. Manganese include Frank B. Jewett Jr., of Vitro, president; Garbade and Dr. Charles Sheer, vice-presidents; and William H. Denne Jr. of Vitro, secretary and treasurer. Other directors include Ward; Dr. John R. Dunning, dean of engineering at Columbia University; Alvin A. Borgading, a Great Divide vice president; and Sellew.

Ungava Nickel Strike in Quebec Stirs Interest

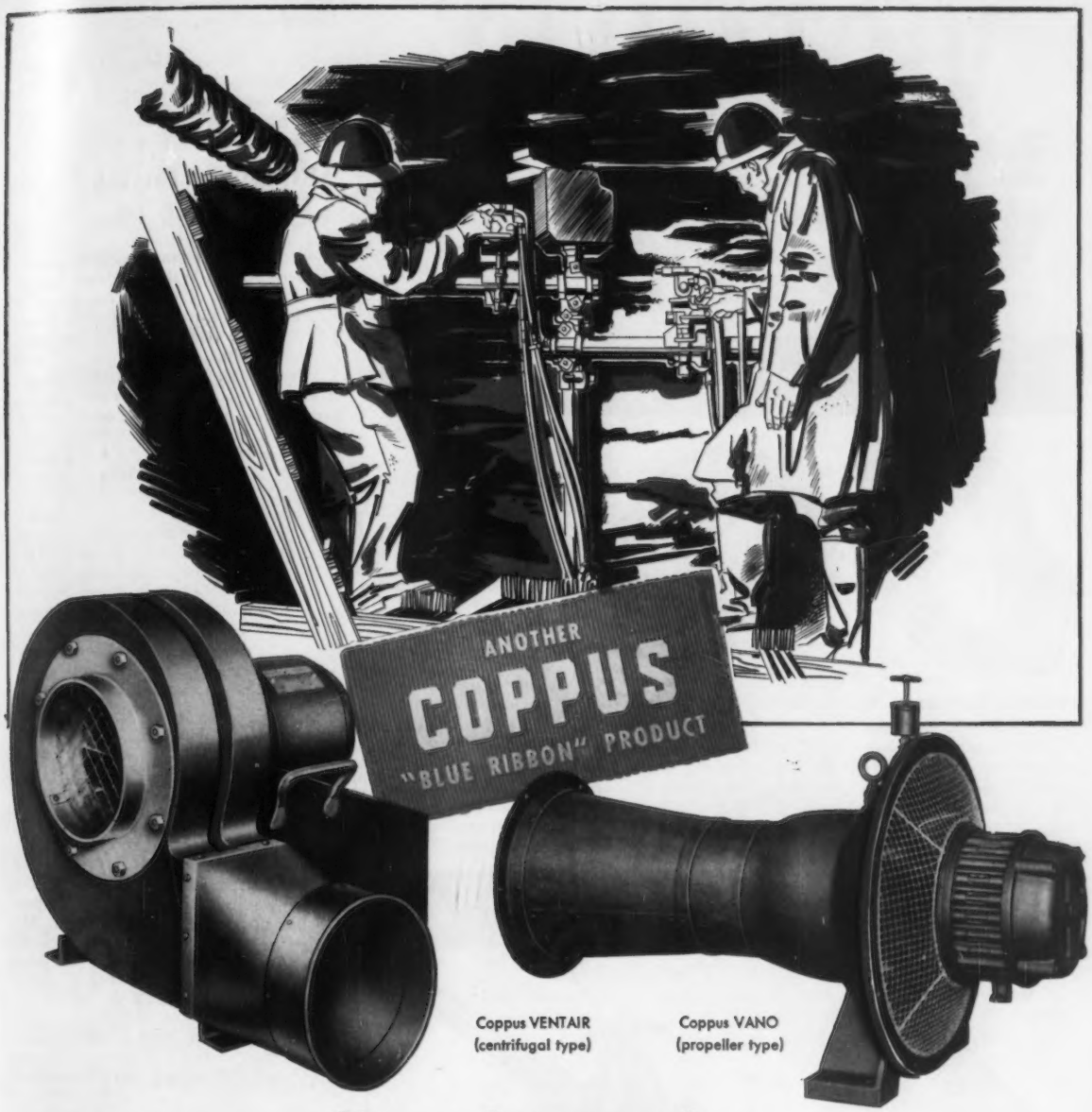
NICKEL HAS BEEN DISCOVERED by Toronto geologist in the far northern Ungava district, Premier Duplessis said and International Nickel Co. has approached Quebec Government for mineral development rights.

During a press conference Mr. Duplessis said Murray Watts of Toronto made discovery 250 miles north of Schefferville, the iron ore mining center 365 miles north of Seven Islands.

Mr. Duplessis said he has received visits from two groups interested in developing deposit and carrying on further research in bleak sub-Arctic area.

One was headed by Henry S. Wingate of New York, president of International Nickel. Mr. Duplessis said Mr. Wingate declared his company is ready to spend $5-million to carry out further research and to invest $100-million in developing the deposit.

The other interested business group is



Coppus VENTAIR (centrifugal type)

Coppus VANO (propeller type)

Choose between them and get 30% to 100% more air

Coppus Blowers are designed for two different types of mine ventilation requirements: the centrifugal Coppus VENTAIR is for long pipe lines; the propeller-type Coppus VANO for shorter lines . . . the correct selection will give you from ⅓ more to twice as much air — for a given power consumption — than an ordinary all-purpose fan.

Available for either compressed air or electric motor drive, both can be used as blowers or exhausters and are obtainable in capacities up to 90,000 CFM.

Only Coppus makes both these types, one of which will give you better, more economical mine ventilation . . . know them by the "Blue Ribbon" that symbolizes the engineering and production skill behind every Coppus product.

Representatives listed in MINING CATALOGS. Other Coppus "Blue Ribbon" products: steam turbines, gas burners, heat killers, air filters, blowers and exhausters for special purposes. See also THOMAS' REGISTER . . . Coppus Engineering Corporation, Worcester 2, Mass.

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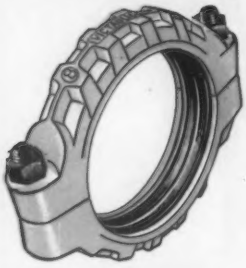

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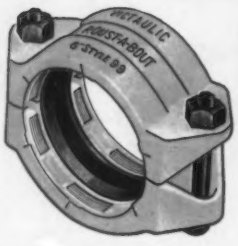
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".



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For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 8".

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The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

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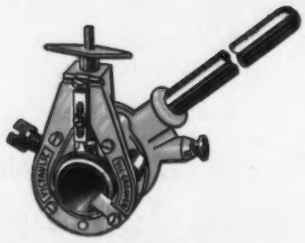
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



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Ungava *(Continued)*

comprised of Mr. Watts, the discoverer, and Robert C. Stanley of New York. There were no details on what this group proposed.

AEC Opens Buying Depot At Lost Creek Plant

PROVISIONAL uranium ore-buying station has been opened by U. S. Atomic Energy Commission at Crooks Gap, Fremont County, Wyo., it was announced at Grand Junction Operations Office of the Commission. Station, to be operated by Lucius Pitkin, Inc., will provide market for Gas Hills and Crooks Gap ores amenable to Lost Creek plant. These ores will no longer be purchased at Riverton, Wyo. Other acceptable ores tributary to Riverton will for the time being continue to be bought at that station.

Provisional buying station will operate at Crooks Gap until permanent automatic sampling facilities are completed by Lost Creek Oil & Uranium Co. sometime in spring. Lost Creek is building uranium processing mill on the site. Permanent sampling plant will be leased to Commission by Lost Creek until processing mill is completed, at which time Lost Creek will take it over to purchase ores for their own account.

Texas City Tin Smelter Sold to Wah Chang

U. S. GOVERNMENT will receive $1,350,000 from sale of Texas City tin smelter to Wah Chang Corp. U. S.'s only tin smelter was built for about $13-million and has depreciated value of about $5-million at present time. Wah Chang intends to use plant to produce tungsten and tin.

Frasch Plant Set For Central Minera in Mexico

NEGOTIATIONS HAVE BEEN COMPLETED for construction of a $3.5-million Frasch process sulphur plant for Central Minera, S.A. by Fish Service De Mexico, it was announced recently by R. R. Herring, president of the latter company. Central Minera, a subsidiary of Texas International Sulphur Co., owns a 123,000 acre sulphur concession on mineral rich southern Mexico's Isthmus of Tehuantepec.

Fish Service De Mexico, Mexican subsidiary of Fish Service Corp., Houston, Texas, is completing geological and engineering studies on deposits located near the village of Texistepec, Vera Cruz.

Reports to date indicate the sulphur deposits justify construction of 1,000 tpd facilities, Fish announcement said. Core drilling and engineering studies have been under way since mid-summer 1956.

In addition to construction, Fish will also train management personnel and maintain active management control of the operation.

NOW...
get all famous Skid-Shovel advantages with NEW mining TD-9!

U. S. BUREAU OF MINES

APPROVAL No. 2409

The components for this new International Drott underground mining tractor were safety-tested and approved at the Bureau of Mines Laboratory, Pittsburgh, Pa. In addition to the built-in exhaust cooling and diffusion system, the Bureau stipulates that for **full** TD-9 engine hp operation, 9,800 cfm of ventilating air be furnished at the mine face.

These three factors provide more than an adequate safety factor!

6 attachments for unmatched versatility!

Exclusive Drott Four-In-One is a dozer, bucket, clamshell, and scraper, all in one.

95-inch Drott bulldozer blade mounts directly onto Skid-Shovel lift arms. Easy to control!

Drott Bullangledozer blade can be angled to either side and has power tilt from operator's seat!

Rock fork constructed of super-strong alloy steel . . . withstands abrasion of loading hard, heavy minerals.

Third, extra valve of Drott Skid-Shovel controls rear-mounted heavy-duty scarifier.

Low profile, 2-prong grapple with top grab arm loads ties or mine props with full control.

You get exclusive wide work range, low equipment investment, and all other exclusive advantages for underground mining—in the new International Drott TD-9 Four-In-One Mining Skid-Shovel.

This new, big-capacity producer with 71 net engine hp and 24-volt direct electric starting meets U.S. Bureau of Mines new safety standards (Schedule 24) for underground, non-coal mining. It features the new short-coupled, stainless steel scrubber—that cools exhaust to a maximum of 160°F, while dissolving irritating aldehydes with water-bath turbulence. Then Drott design produces an extra-safe 75 to 1 diffusion ratio by fan stream action on the final exhaust —to break up noxious gas concentrations. (Only a 40 to 1 ratio was required!)

"Mine-tunnel" maneuverability

In addition, low, "trolley-clearing" profile (only 6' tall) and standard length of the new machine provide unmatched full-load maneuverability, even in cramped quarters. You get all the famous Drott exclusives, too, like triple-power pry-action break-out, and shock-swallowing Hydro-Spring!

Prove the great versatility, operating ease, and safety of the new underground International Drott TD-9 Four-In-One Mining Skid-Shovel. See your International Drott Distributor for a demonstration.

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Extensive use of these tables at mines both domestic and foreign, is proof of their completely satisfactory performance. Records show that the SuperDuty table produces highest grade concentrates while, at the same time, holding tailings losses to a minimum and greatly reducing the volume of middlings for recirculation.

The operation of this efficient table is explained fully in Bulletin 118-B, which will be sent gladly to engineers and other interested persons on request. Send for your copy today.

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This all steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separations made by each main cell. Advantages offered are: (1) accurate classification or sharp sizing, (2) easy and effective hydraulic water regulation, (3) as many spigot products as there are cells, (4) continuous discharge, (5) no moving parts, (6) low maintenance cost.

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Mining Calendar

Annual Meeting, AIME, Hotels Roosevelt and Jung, New Orleans, La. Feb. 24-28

Prospectors & Developers Association annual meeting, Royal York, Toronto, March 3-6

American Congress on Surveying and Mapping—American Society of Photogrammetry consecutive meetings, Shoreham Hotel, Washington, D. C. March 3-9

Nuclear Congress, NICB, AIChE and other societies. Philadelphia Convention Hall. March 11-15

Tenth Western Metal Congress, Ambassador Hotel, Los Angeles, Calif. March 25-29

Pacific Southwest Mineral Industrial Conference, AIME, Reno. April 5-6

Eighth Annual Symposium on Spectroscopy, American Association of Spectrographers, Hotel La Salle, Chicago, Ill. April 29-May 1

Uranium Institute of America annual meeting and mill symposium. Denver, Colo. May 17-18

Second Reactive Metals Conference, Southern California section AIME, Los Angeles, Calif. May 28-29

Vacuum Metallurgy Lectures, NY University, University Heights, N. Y. June 10-14

IN THE U. S.

ALASKA

Uranium mining will go on a producing basis in Ketchikan area, according to official of Climax Uranium Co. Company expects to start producing on first big strike made at Ketchikan early in 1956 by Don Ross and Kelly Adams.

Ovela Cote, president of British Columbia Mica Mines, announced his company plans to open mine near entrance to Portland Canal on Stiklan Island east of Ketchikan next spring. Cote said in Ketchikan that past three years have been spent in exploratory work.

ARIZONA

At an old timers dinner of Inspiration Consolidated Copper Co.'s employees at Inspiration, Ariz., P. D. I. Honeyman, vice-president and general manager, announced company confidence in the Christmas mine which Inspiration took over in 1953 where it since has been conducting exploration work.

Colorful mining camp is high in the hills above Gila river, 9 mi. north of Winkleman. Honeyman said it should get a new town within a year.

"We think we have a mine," Honeyman said. "We're sinking a new shaft 1,700-ft deep." He expects production in 1959.

Arizona *(Continued)*

Anaconda Co. has withdrawn from exploration work at Superior, Ariz., dropping purchase agreements and options held on claims in the district. Anaconda optioned copper properties and later transferred 40% interest to Inspiration Consolidated Copper Co. Drilling results were disappointing. Properties included the Belmont Copper Mining Co., Queen Creek Copper Co., Magma Superior Copper Co., and Grand Pacific.

CALIFORNIA

Preliminary figures released by U.S. Bureau of Mines show 1956 mineral production topped 1955 by some $56-million.

Metals were up $2.5-million from previous year, and nonmetals showed an $18.5-million increase. Mineral fuel production rose $35-million.

Picture improved for all metals except gold, mercury and tungsten.

Tungsten was hit by delays in renewing the Government purchase program. However, molybdenum—byproduct of tungsten production—was produced in greater quantities, suggesting that tungsten is being stockpiled. Leading tungsten producers were Wah Chang Mining Corp., Surcease Mining Co., and Union Carbide Nuclear.

Mercury production slipped — due partly to development work done at expense of production—but California is still the nation's leading producer.

Gold decline was underlined by closing of several veteran gold properties, including Empire Star mines (shut down) and Idaho-Maryland (surface plant sold.)

Chromite production increased slightly, spurred by General Services Administration's carlot program.

Copper also went up slightly, with the Pine Creek operation in Inyo County main contributor. Entrance of Phelps Dodge into Shasta County region was expected to put new vigor into that copper mining area.

Iron ore output rose, major factor being increased production at Kaiser Steel's Eagle Mountain mine to feed its Fontana steel mill.

Manganese production was almost twice that of 1955.

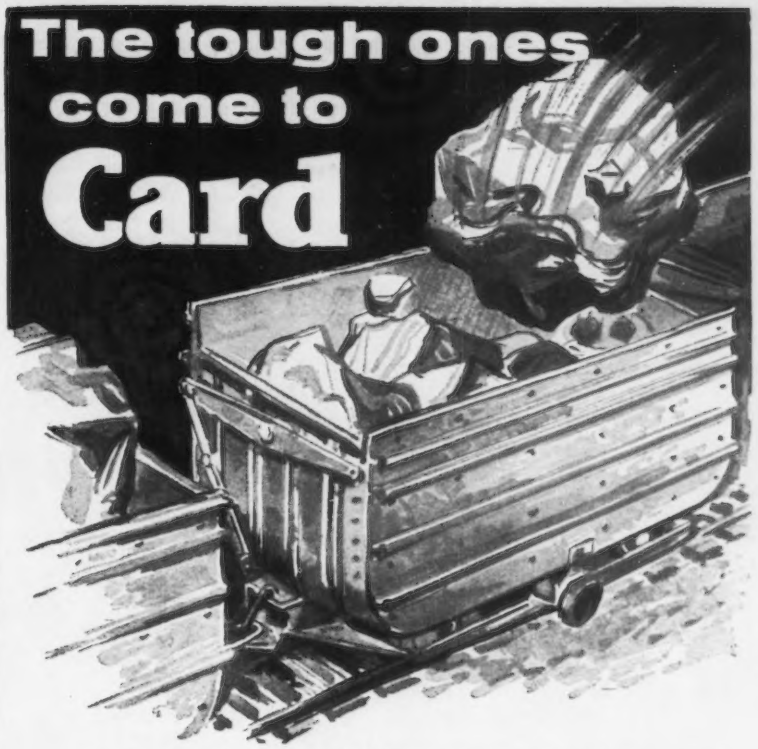
Lead-zinc also rose, largely because of Anaconda's stepped-up activity at Darwin and Shoshone mines in Inyo County.

Silver production was up.

Nonmetallics also showed a healthy rise. California remains nation's biggest producer of sand and gravel. State has become top producer of magnesium compounds from sea water—this source being used increasingly instead of magnesite ore.

Here are the preliminary 1956 production totals, as compared to 1955:

Chromite, $2,074,500 as opposed to $1,834,277; copper, $670,000 compared with $457,298; gold, down to $6,818,000 from $8,810,795; lead, $3.2 million compared with $2,462,970; manganese, $424,000 for '56 compared with $270,519; mercury, slipped to $2,210,000 from



In hard rock mining, haulage equipment takes a real beating. Three-ton boulders drop ten feet and more into mine cars with a force that dents good half-inch steel plate. CARD cars have whipped these tough conditions for many of the major ore producers of the western hemisphere.

Familiar names like these and many others dot the C. S. CARD customer lists over and over with their repeat orders. CARD cars built to order for these firms cost little more than standard stock models, yet they result in large savings because they are built to handle specific mining requirements.

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- **BOX-SEAT COMFORT AND VISIBILITY . . . satisfied operators . . . more and better work done on all grading jobs**

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These are five of many reasons why Allis-Chalmers FORTY FIVE motor graders are showing up in more and more mining and quarrying operations. They are precisely what the dirt-moving specialists ordered . . . ready now to handle haul road construction and maintenance easily, smoothly. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

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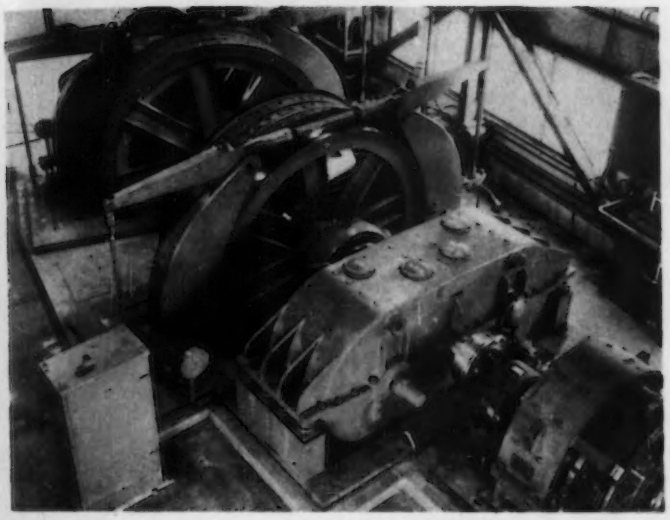

Two ore hoists and one Service hoist installed in one headframe at the Cleveland Cliffs Iron Co., Cliffs Shaft Mine, Ishpeming, Mich.

Skip load 15 tons
Max speed. 2000 ft/min
Max depth. 4000 ft.
Pushbutton operation.

Pioneering in the design and development of multi-rope, friction-drive hoists, ASEA offers the advantage of its engineering background and wide experience in this new concept in mine hoisting. 14 ASEA mine hoists on order for the U.S. and Canada—6 now operating.

ASEA equipment sold and serviced for the U.S. by . . .

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California *(Continued)*

$2,867,206; silver, $874,000 as opposed to $863,582; zinc, $2,187,000 as compared with $1,681,656; tungsten concentrate, $14,150,000 for '56, compared with $16,200,924.

Key nonmetallics: cement, up from $103,793,702 to $117 million; gypsum, down from $3,273,724 to $2,750,000.

High-grade uranium strike, perhaps richest yet made in California, has been claimed by Kern Uranium Co. in Kern Canyon, 36 mi. northeast of Bakersfield, Kern County. Strike was made on Little Sparkler claims at a depth of 14 ft in surface pits. Blackish ore, believed to be uraninite or pitchblende, was found in a 32-in. face. Select sample assayed at more than 10%, Lloyd Scouler, partner in Kern Uranium, said.

Macco Corp. completed construction of a $120,000 concentrating plant at Linne in Indian Wells Valley, Kern County. Plant is being used to concentrate and refine barium sulphate. Ore is mined open-pit from deposit owned by Western Barium Co., San Francisco, in Nine Mile Canyon. Four new $20,000 trucks and trailers haul ore to the plant.

Macco is running one 8-hour shift daily, with a six-man crew operating plant. Processed ore is hauled to Macco's Rosamond, Kern County, plant for mixing with other ingredients to form oil well drilling mud.

Plant currently handles 400 tons of ore per day.

John Robinson is manager. Bill Paine is plant superintendent.

COLORADO

Camp Bird, Ltd. of London, England, has started a $1-million development program at the famous old Camp Bird Mine near Ouray, Colo.

British firm has resumed active control of property since expiration of a 30-year lease held by King Mining Co.

Camp Bird Ltd. purchased mine from Thomas F. Walsh in 1900 and operated it until 1926 when it was leased to King.

C. P. Tremlett, acting manager at Camp Bird, said the new development is designed to produce zinc, lead and copper.

Eighty men are now at work. Employment will be increased to 200 by mid-1957, Tremlett said.

Gold receipts at Denver mint totaled 57,773 oz, worth $2,022,082 in November, mint officials report. Total for November, 1955, was 55,717 oz valued at $1,950,091. Silver receipts for month were down to 14,249 oz, worth $12,908 from 15,367 oz, worth $13,919. Silver receipts remain low because world silver price is above fixed government price.

National Mineral Corp., Chicago, has purchased controlling stock interest in Superior Mines Corp., Colo., which since 1945 has owned and operated the Rawley, Superior and Erie group of claims in Saguache county. National

Colorado *(Continued)*

Mineral Corp. has taken full charge of operations in Saguache country and placed Forbes Smith, London, England, an experienced mining engineer, in charge.

Colorado Springs men have discovered what they claim is largest and richest beryl mine in U.S. Discovery was made in the Old Boomer Mine located about 11 miles northwest of Lake George in Park County. Owners of property are G. H. Sager of Colorado Springs and Clyde Allen of Florence. 23 claims of the property, much of it patented land, is leased by T. C. Nelson and Art Lowrey, both of Colo.

The name of their firm is the Lowrey-Nelson Mining Co. They have already shipped 11 truckloads of the beryl ore to a government buying station at Custer, S.D. Some of the ore has been worth as much as $500 a ton, according to Ed Douglas of Colorado Springs, who is engineer and geologist for the mining company.

Opportunities, pay, and fringe benefits in U.S. Bureau of Mines were never better, J. H. East, Jr., Regional Director, Denver, said in announcing an "emergency recruitment" campaign to obtain professional and scientific employees for intensified research on minerals essential to industry and defense.

More engineers, metallurgists, chemists, physicists and other technically trained personnel are needed to carry out challenging $22-million program on strategic metals and non-metals authorized by last Congress, East stated.

FLORIDA

NRC Metals Corp. has been granted necessity certificate by Office of Defense Mobilization for its zirconium production plant now under construction in Milton, near Pensacola. Certificate grants five-year depreciation period on 75% of $7,230,000 estimated cost of the plant.

NRC Metals Corp, wholly owned subsidiary of National Research Corp, Cambridge, Mass., received a $22,750,000 five-year production contract from Atomic Energy Commission in May, 1956, to supply 700,000 pounds per year of reactor-grade zirconium.

Plant will have considerable excess capacity to provide commercial grade product for use in chemical, food and petroleum processing plants where it shows unique corrosion resistance.

IDAHO

American Smelting and Refining Co. served notice that old Frisco Mine on Canyon Creek northeast of Wallace would be permanently shut down on December 31, 1956.

Constantly rising costs without compensating increases in metal prices was reported to be responsible for closure. Property had operated at a loss every month but two since the mine was reopened on February 1, 1956.

Company officials said a large percentage of Frisco's 80 employees would be transferred to other Asarco operations in the Coeur d'Alene district on the basis of seniority and qualifications.

Promising new ore discovery has been made in American Smelting & Refining Co.'s old Morning Mines at Mullan. Exploration crew driving new west drift into a previously-unexplored section of Noonday vein has opened good-grade lead-zinc ore three- to four-feet wide for a distance of more than 50 ft on 1250-ft level which is 450 below main haulage tunnel. If ore shoot persists, it could be a significant factor in prolonging mine life, company officials said.

Noonday vein, which runs parallel to big Morning structure, was never a big producer from its easterly workings. Its western end has never been explored.

Morning Mine has been in steady production for 67 years and at times employed as many as 700 men. Lower workings were closed down in 1953, but exploration has been continued in old upper levels and the property is still producing from 200 to 250 tpd.

Polaris Mining Co.'s two-mile-long east

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Field performance has amply proved these bits to be the driller's answer to **large hole** problems. They are made special, to your specifications and design, in any diameter; size and weight limited only by the handling capacity of conventional drilling rigs. They can be furnished to run on drilling stem or with integral rope socket top.

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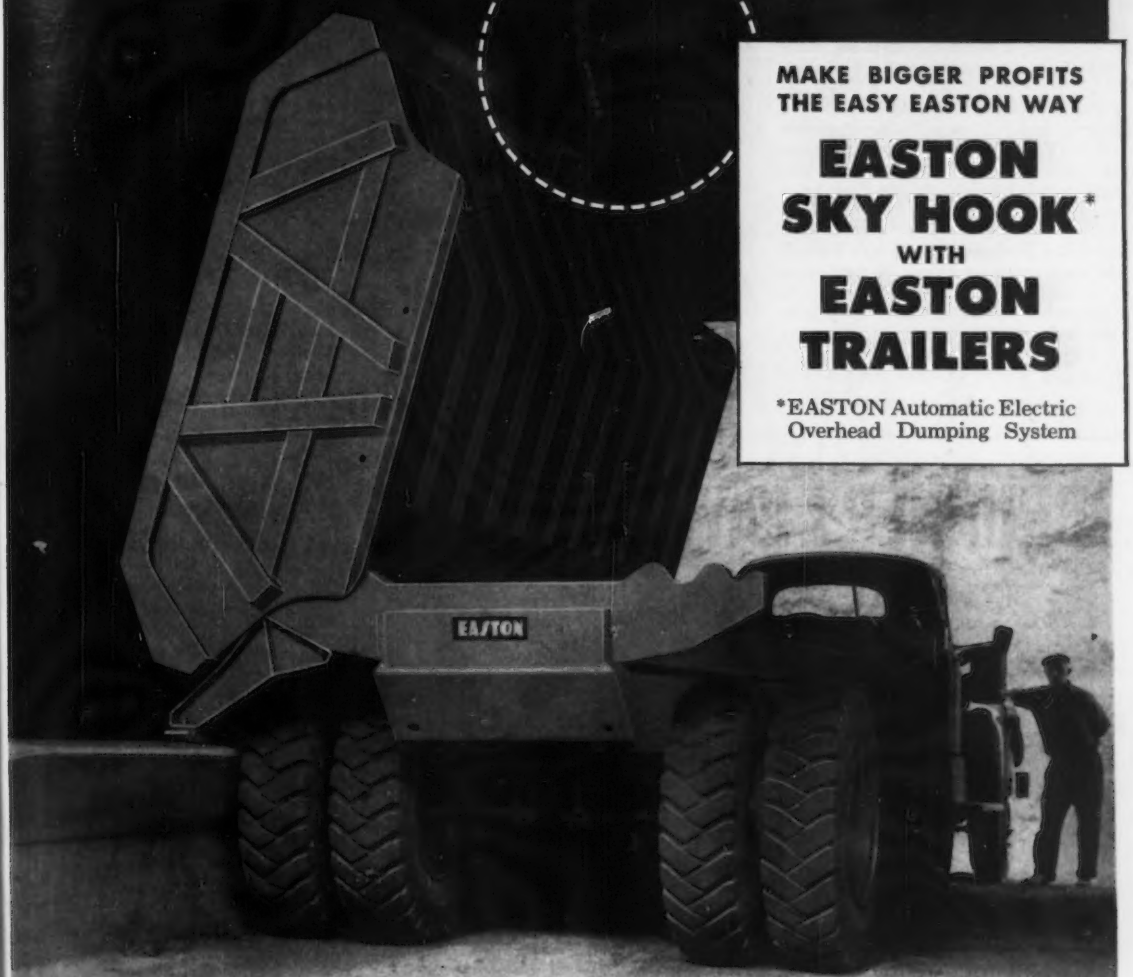

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Idaho *(Continued)*

exploration lateral from 3,000-ft level of Silver Summit shaft has encountered "encouraging" silver-copper ore beneath property of Rainbow Mining & Milling Co. in the silver belt southeast of Osburn. Initial crosscut intersection of mineralized zone showed 2.8 ft of commercial-grade tetrahedrite. Drift-work along structure is now in progress to determine importance of the discovery.

East lateral is a DMEA project which Polaris is carrying out under an operating agreement with property owners east of its Silver Summit Mine.

All operations at the Cummings-Roberts open-pit fluorspar mine on Crystal Mountain in Ravalli County, Mont., have been suspended for winter because of heavy snows. Mine is at an elevation of about 7,000 ft in mountains east of Darby. Mining and milling operations were discontinued early in November, but a skeleton crew was kept on development work until late December. Crystal Mountain Mine, Montana's only fluorspar producer, yielded about 60,000 tons last year.

Clearwater Dredging Co., Idaho's leading gold producer, discontinued its operations on Crooked River in Idaho County early in December for usual winter shutdown. Company's dredging permit was cancelled by Idaho Land Board last summer for alleged failure to keep river waters "reasonably clear," but operations were continued pending court action on company's appeal for a review of decision.

Officials of Clayton Silver Mines report that 1956 was best year in company's 20 years of operation at Clayton Mine in Bayhorse District, Custer County. Gross smelter receipts last year amounted to about $750,000, as compared with slightly more than $500,000 in best previous years.

Increased silver values in North ore body on new 550 level were said to be responsible for improved earnings.

Sinking of a winze near North ore body to about 700 horizon is scheduled to get underway early this year.

Metropolitan Mines Corp. and its Black Bear Silver-Lead Mines Co. affiliate have applied to American Smelting & Refining Co. for a lease on old Frisco Mine workings above 1,600-ft level with view to driving an 1,800-ft easterly crosscut from that lower horizon beneath their adjoining Black Bear Mine.

Proposed tunnel would gain approximately 1000 ft of depth on present workings on Black Bear lead-ore body which has been mined upward for about 600 ft above the Black Bear adit level.

Hecla Mining Co. has abandoned its exploration project on Big Flat-Tucker Flat properties in Big Indian District of San Juan County, Utah, and surrendered possession of the claims to the owner,

Hunter Creek Mining Co. and Inspiration Lead Co. have disclosed plans for a merger with Dayton Consolidated Mines Co., Silver City, Nev. Consolidation, proposed by Nevada firm after Hunter Creek and Inspiration Lead had acquired a 51% stock interest in company, has been approved by the boards of directors and will be submitted to stockholders for ratification or rejection in near future.

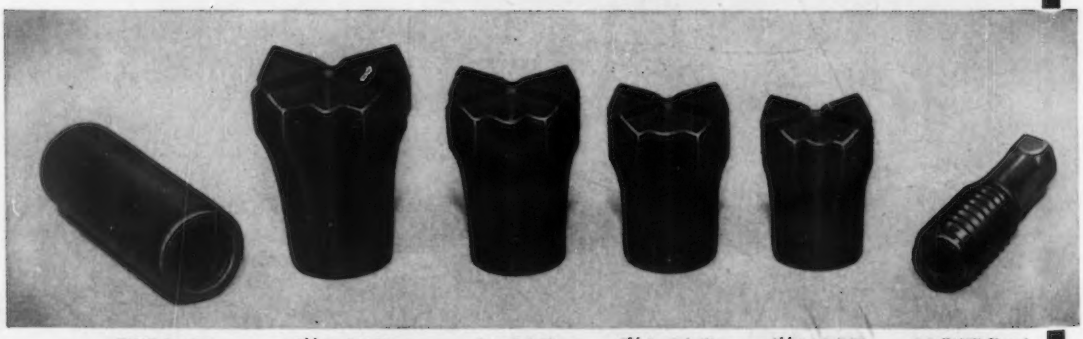
Both Hunter Creek and Inspiration Lead have mining properties in Coeur d'Alene district. Silverore Mines Inc. will also be given an opportunity to participate in merger because of its working agreement with Inspiration Lead on their adjoining Coeur d'Alene district claims northwest of Wallace.

Dayton Consolidated, one of largest property owners in Comstock area, with completely equipped mining and milling plant, was a profitable gold mining operation and one of Nevada's leading gold producers prior to World War II order by War Production Board closing domestic gold mines. Firm now has a suit pending in federal courts against the Government for $1.5-million damages resulting from enforced shutdown.

MICHIGAN

M. A. Hanna Co. is transferring about 40 of its Hiawatha mine men to new Cannon mine. Hiawatha is oldest oper-

BRUNNER & LAY "600" ROK-BITS



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Brunner & Lay "600" carbide Rok-Bits® designed to fit directly on "600" series extension drill rods. No adapter needed! Rok-Bits' "X" design eliminates rifling, gives you a ROUND hole to load. Wider chip channels permit discharge of more and larger chips. Order from your distributor—if he cannot supply you, contact our nearest plant. Write for Catalog #756.

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How a new **CAT*** No. 12 can

STEP UP YOUR MINE'S EFFICIENCY 3 WAYS

This new Caterpillar No. 12 Motor Grader maintains 16 miles of haul road and 'dozes truck spillage at the Hill-Trumbull Mine, Marble, Minn. It is owned by the Mesaba-Cliffs Iron Company and operated by the Cleveland-Cliffs Mining Company of Cleveland, Ohio. In building and maintaining haul roads for faster cycle times and reduced wear and tear on equipment, in 'dozing and clean-up work, the new Caterpillar No. 12 does a big and important job. Here is how it can do it at lower cost in *your* mine:

1. LOWER OPERATING COST. The new No. 12 delivers its 115 HP on non-premium, low-cost fuels. Its new oil clutch gives you longer clutch life, easier operation, and as much as 1500 hours between clutch adjustments. Tubeless tires (furnished at no extra cost) run cooler, last longer, and eliminate the tube and flap down time of old-fashioned tires.

2. LONGER WORK LIFE. Like all Caterpillar Motor Graders, the No. 12 is built—not just assembled—by a single manufacturer. This means traditionally sound Caterpillar ruggedness and workmanship, and careful balancing of engine and blade capacity for long life and high efficiency. And it means a single source for parts and service—your reliable Caterpillar Dealer.

3. INCREASED PRODUCTION. Positive, non-creep controls, easy "feel-of-the-road" steering, sure-footed traction with engine positioned over the driving wheels, quick-change blade positioning, unobstructed visibility—all these are good reasons why operators *like* the Caterpillar No. 12 Motor Grader, and do more efficient work on any job.

Your Caterpillar Dealer will demonstrate these and other features of the fast-working, long-lasting No. 12 Motor Grader. See him for proof that the Cat No. 12 will do more work at less cost on *your* job than any other grader.

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ROTARY ROCK BITS

- because of their hard-faced cutter teeth of field proven design
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Michigan (*Continued*)

ating mine in the district and as its production is gradually being reduced to prolong its life, Cannon is becoming further developed and able to absorb those released from Hiawatha. No reduction in total employment or production is involved.

MINNESOTA

Total iron ore shipments from Lake Superior area for 1956, as announced by Lake Superior Iron Ore Association on Dec. 27, were 77,633,027 tons. While this total is 9,826,826 tons less than that for 1955, considering the five weeks steel plants were closed down because of steel strike, the tons of ore per operating week available to furnaces will not be greatly less than for last year.

President R. T. Elstad, Oliver Iron Mining Division said that the division had completed "the longest ore season in its 64-year history, shipping over 30-million tons of iron ore and concentrates." Included in that total were over 5-million tons of high grade concentrates from taconite and low grade ores.

Oliver mines handled 83-million tons of material in 1956 to obtain something over one third that tonnage of ore shipments. Its mines are scheduled to move 24.7-million tons of overburden before April 1, 1957, which should provide employment for all Oliver men during the winter.

Early in 1956, Oliver announced it would construct or install ore sizing facilities at six Mesabi mines, including four ore concentrating plants. "These units will be in operation in 1957 and will provide new jobs for 150 men."

New cyclone section of Hunner mine (M. A. Hanna Co.) heavy media plant is more than half completed and is expected to be ready for 1957 ore season. At Hanna's Morton mine, the skip pocket has been lowered and belt conveyor stripping system has been dismantled and stored. Rock stripping with standard shovels is on a 21-shift per week basis. At the Mississippi group, 25,000 gal water tank has been moved about 600 ft west to clear room for a new pit-approach road.

Erie Mining Co. is installing what is believed to be world's longest "hot material" conveyor belt at its new taconite pelletizing plant at Hoyt Lakes. The 1400-ft long, 42-in. wide, six-ply, extra-heavy rayon and rubber belt will carry more than 2,000 tph of taconite pellets at temperatures up to 250 deg at 525 ft per minute, driven by 300 hp motor.

Conveyor will feed a huge stacker which is being erected. This stock-piling combination of conveyor and stacker will be capable of disposing of over 4-million tons of pellets during the winter months on an area 800 x 1300 ft and 90-ft high.

R. T. Elstad, president, Oliver Iron Mining Division and W. P. Snyder, Jr., president, Snyder Mining Co., in a joint statement Dec. 15 announced that Oliver has assigned its lease to Godfrey underground mine to Snyder Mining Co.

Godfrey is located between Hibbing and Chisholm and includes a large acreage. Oliver closed the mine in March 1955, with shipments of 90,227 tons that year. Total shipments from mine, which was opened by Oliver in 1926, have been 11,626,609 tons. Estimated 10.5-million tons remains.

Snyder Mining Co. will operate mine in connection with its South Tener Reserve property which adjoins Godfrey. South Tener has shipped a total of 240,000 tons and has 1,851,284 tons remaining. Mr. Elstad said that W. R. Burt estate, owners of the Godfrey fee, had made some concessions in the lease to Snyder Co. because of "the added expense of treating low grade ores found in Godfrey."

On Dec. 12, carrier B. F. Affleck of Pittsburgh Steamship Division loaded with 12,000 tons of iron ore was severely damaged when it struck the Duluth ship canal's south pier. It was afterwards beached in inner harbor.

Charleson Iron Mining Co. finished its season Nov. 5. Its jig plant at Virginia which has treated lean ore stockpiles at Missave Mountain and Minnewas mines was closed on that date after total shipments from 1949 (when 14,449 tons was produced) to date of 1,315,000 tons. Plant has been closed permanently because type of lean ore which it has treated for eight years has been exhausted. Company's next operation will be at its property of 1,000 acres near Atikokan, Ontario, south of Steep Rock's operation, from which it expects to ship ore in 1958. Some of the Virginia plant may be transferred to new mine.

Severe December weather continued and last boat to load at Duluth, Missabi & Iron Range docks at Duluth-Superior harbor was on Dec. 15. At this road's Two Harbors docks, P. R. Clark took on 17,400 tons of ore on Dec. 19 to be last boat to leave Lake Superior ports and officially end 1956 iron ore shipping season, latest closing date since 1899. Because of ice in Sault Ste. Marie river, the icebreaker Mackinaw was ready to assist the last boats when necessary. Sault Ste. Marie locks were closed on Dec. 21 instead of Jan. 1 as had been hoped.

MONTANA

R. S. Kersh, vice president of the northeastern region for Westinghouse Corp., announced that Anaconda Co. has purchased equipment to drive and control the two most powerful mine hoists ever to be installed in U. S.

Hoists go into 4720-ft deep Ryan shaft in Butte. They will be capable of hauling copper ores at rate of 18 tons a minute. Sinking of Ryan shaft is expected to be under way early in 1957.

Order totals over $1-million and includes motors, motor-generator sets, and speed control equipment to drive each

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Reels Ready to Roll When You Need Wire Rope

Stocks on hand . . . that's good to know when you need wire rope. It assures steady production on your equipment when time counts most.

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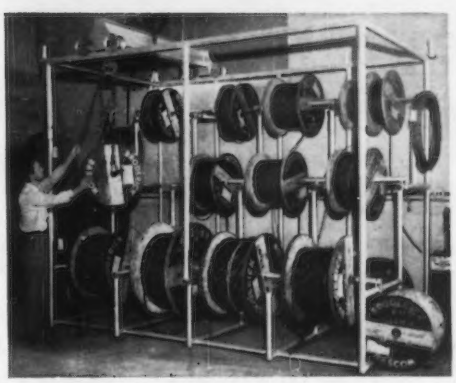

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Montana *(Continued)*

hoist and a payload of 18 tons up the vertical shaft at a rate of better than 30 mph. Hoists will operate from four levels, the shallowest 1636 ft, and the deepest 4720 ft below shaft collar. Total cycle time will be less than two minutes.

Two 3,000-hp motors, each powered by a 2,500-kw motor-generator set, will drive each hoist.

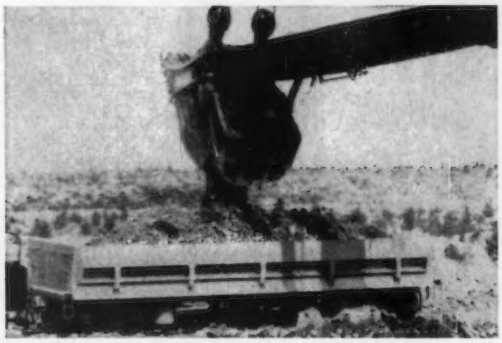
Montana Land Board assigned a Teton County iron ore mining lease to a Duluth, Minn. Corp. at its meeting on Dec. 12, 1956.

Area is about 18 miles west of Choteau. Some board members expressed optimism that Winston Brothers Corp., Duluth may develop the ore.

NEVADA

Kennecott Copper Corp. completed mining at its Kimbley Pit in White Pine County Dec. 31. During six years in which operations were carried on at the site, 20-million tons of material was removed, consisting of 14.5-million tons waste and more than 5-million tons ore. Final dimensions of the Kimbley Pit were 1,350 ft by 548 ft.

they can take it . . .



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. . . at the dump a mighty heave-ho from two powerful air cylinders and the load slides off either side. A 50° dumping angle leaves nothing in the car but an empty look. It's all part of the Differential story on dependable, economical performance . . . they **can take it** and they **can leave it!** And **you're** ahead.

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SINCE 1915 PIONEERS IN HAULAGE EQUIPMENT

During 1956 Getchell Mine Inc., Humboldt County, has mined and processed about 203,000 ton tungsten ore from its properties and has milled in addition about 77,500 tons on a fee basis for Union Carbide Nuclear Co. Union Carbide's ore came from Riley Mine not far distant from Getchell. In addition, about 9,400 tons of ore were milled on a custom basis for 22 other producers.

Standard Slag Co., Gabbs, is operating at capacity and during 1956 turned out about 40,000 tons of finished refractory products. They also shipped about 450,000 long tons of iron ore from two different properties. Exploration projects were carried out by company during the year at sites in both Nevada and California.

Work is being pushed forward rapidly on construction of new mill by Apex Minerals Corp., Austin. Ground has been graded and excavation is now under way preparatory to laying heavy foundations. Negotiations for the purchase of plant equipment are in progress and due to location of the site little road building will be necessary.

Apex completed its work of connecting Adit No. 1 with Adit No. 2 at its uranium mine. Purpose was to permit dropping ore from one level to other. Development work is progressing at mine and a large new orebody is indicated by scintillometer. Crosscut No. 3 out of Adit No. 1 is being pushed ahead to intercept downward extension of orebody already developed.

During the last six months of 1956, Eureka Corp. Ltd., which operates its mine near Eureka, carried out drifting and crosscutting totalling 2215 ft, and did 12,310 ft of diamond drilling on 850-, 950- and 1,050-ft levels. The 906 orebody has been partially outlined to the west of 902 drift for a length of 200 ft, giving a preliminary estimate of 62,500 tons with 20% dilution grading tentatively 10.4% Pb, 5.7 oz Ag, and 0.354 oz Au.

Report to stockholders said in part: "Installation of a larger hoist at TL shaft is practically completed and will greatly increase hoisting capacity when placed in service."

NORTH CAROLINA

King's Mountain Mica Co., Kings Mountain, has begun production at its new plant on Charlie Moss property south of Kings Mountain.

New plant is producing scrap mica, and ore reserves on the Moss property have been estimated at "conservative 25 years." Lease on property covers 200 acres, of which 30 acres have been used for three reservoirs. One of the reservoirs is settling basin, another is water reservoir and third is fresh water supply.

Kings Mountain Mica, with its predecessor company, has operated since 1948, and has employed nine new workers to handle new operation. Paul Lancaster, company manager, said supervisory personnel will be the same at both plants.

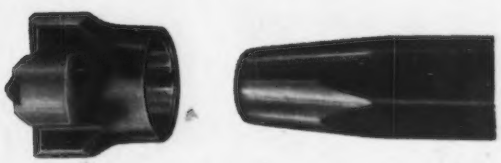
Now for the first time, a tungsten carbide insert bit, "drilled to destruction without the need of resharpening." Lower first cost, lower cost per foot drilled.

FORGED FROM SPECIAL ALLOY STEEL FOR STRENGTH AND TOUGHNESS

LIDDICOAT
TEE CEE BIT

Liddicoat was the pioneer in the development and manufacture of the single-use steel bit. Now, after years of experience and research, there has been developed a tungsten carbide-insert Liddicoat bit that completely revolutionizes drilling with carbide bits. The new line of Liddicoat TEE CEE bits (patents applied for) are "drilled to destruction without the necessity of re-sharpening." The design of the bit and inserts is such that even when dulled a reverse taper does not occur. In the conventional multi-use carbide bit, a reverse taper stops drilling. The four-point bit permits fast collaring, fast cutting, and easy removal from the hole. In spite of these many desirable features, this bit is offered at a new low first cost, which provides low cost per foot of hole drilled.

TAPER SOCKET... NO THREADS FAST, FIRM ATTACHMENT



Illustrated is the improved taper perfected to provide ease of attachment and removal. No threads to strip; longer rod life.

Because of spectacular performance, the Liddicoat single pass taper socket Tee Cee bit is already in use by many of the world's important mining and construction companies.

For information contact your Liddicoat Dealer or Western Rock Bit Manufacturing Company.

WESTERN
Rock Bit Manufacturing Company

552 West 7th South • Salt Lake City 4, Utah

TEXAS

Texas Gulf Sulphur Co. has started building a "multimillion dollar" sulfur mining plant at Fannett Dome in Jefferson County, according to latest reports.

UTAH

Utah Construction Co., world-wide mining and engineering firm, will transfer its headquarters from Utah to Delaware. Board chairman M. S. Eccles, Salt Lake City and San Francisco, said move would eliminate some double taxation, permit launching of an employee stock participation program and add other tax benefits.

Kennecott Copper Corp., world's biggest producer of copper, mined, milled and refined approximately 25% of nation's new copper during the year.

In addition to expending over $100-million for payrolls, supply purchases, services and taxes, company spent a total of $6,149,919 in major expenditures to improve operating efficiency at mine, mills and refinery, according to company's annual progress story.

Significant event was successful negotiation of three-year labor contract which holds promise of stable copper supply and continued benefits to people of Utah through copper production uninterrupted by labor disputes.

Close of 1956 also marked first year of commercial production by company's new $2-million vertical casting wheel at its Garfield electrolytic refinery.

1956 marked beginning of a $12-million, 18,000-ft, ore haulage tunnel construction project from bottom of Bingham Canyon open-pit mine to Copperton assembly yards on east side of the mountain.

When completed, in about two years, tunnel will be 18-ft wide and 24-ft high and will accommodate a single standard gage railroad. Mine is served by two other tunnels, progressively being shortened as pit expands. They are the 6040-ft level tunnel finished in 1945 and the 5840-ft level tunnel finished in 1953.

Haile Mines Corp., U. S. producer of tungsten and manganese, has established western regional exploration headquarters at Salt Lake City.

Dr. Eugene Callaghan, who recently resigned as director, New Mexico State Bureau of Mines and Mineral Resources, will be chief geologist in charge of exploration.

Dr. Callaghan has world-wide experience in search and evaluation of metals. He is graduate of University of Oregon and Columbia University.

Western Gold & Uranium, Inc., announced completion of its silver mill and initial processing of uranium-silver ore at Silver Reef property near Leeds. First 15-ton shipment of silver concentrates left the site recently. Uranium section of mill also is under construction and will be completed late in February.

Company's Big Hill mine at Silver Reef is believed the only one in country yielding ore containing silver and uranium, both of good commercial grade. Abundant dumps from old silver mines in area, which contain from 6 to 16 oz Ag per ton and can be handled cheaply, also will be processed through new mill.

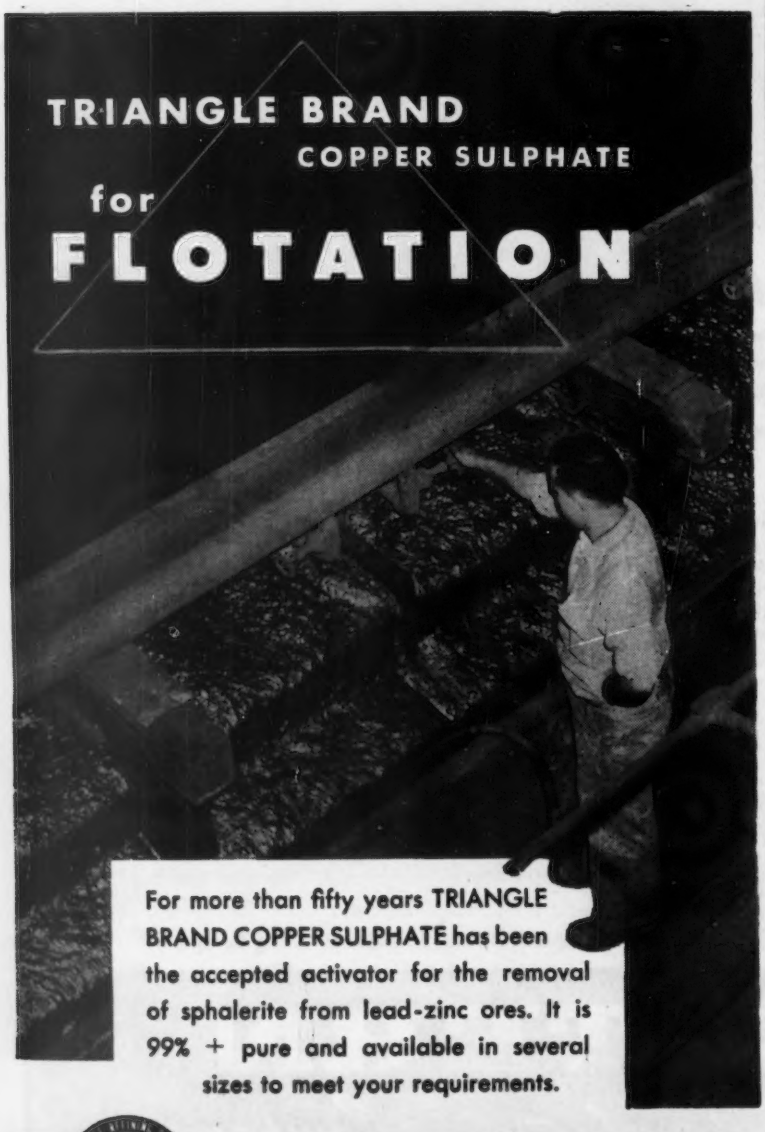
Uranium-bearing ore, after extraction of silver, will be shipped to Vitro Uranium Co.'s mill at Salt Lake City. Combined milling operation will be carried on at 50 tpd and yield profits of about $25,000 per month.

Radorock Resources, Inc. has repaid Hecla Mining Co. for all development work on Radon mine, San Juan County, Utah. Firm also has retired a $300,000 bank loan and is now debt free, officials announced.

Company, affiliate of Federal Uranium Corp., Salt Lake City, paid Hecla $817,076 according to interim report from president R. W. Neyman, who also heads Federal.

WASHINGTON

W. E. Sherman, Tacoma, and C. C. Sherman, Omak, are planning shaft development at their 600-acre property in Ruby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For more than fifty years TRIANGLE BRAND COPPER SULPHATE has been the accepted activator for the removal of sphalerite from lead-zinc ores. It is 99% + pure and available in several sizes to meet your requirements.
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Put your haulage requirements in experienced hands...

...the **SURE** hands of experience which have specialized in the manufacture of heavy duty trucks for over 53 years. Model 35SL (shown above) carries 35 tons (24 cubic yards, struck). 400 HP Diesel with down-hill retarding hydraulic torque converter. DART-designed-and-built 50,000 lb. front axle and 110,000 lb. capacity drive axle and DART'S famous box girder frame give this truck superior strength.

Model 10SL. DART'S Jr. Workhorse. 10 ton capacity, powered by 150 H. P. diesel driving through a double reduction rear axle. Tires are 12:00 x 24 all around. Hydraulic steering and torque converter, optional.

Model 25SL. The famous DART standard dump truck. 300-335 H. P. diesel engine and hydraulic torque converter with built-in down-hill retarding. Hydraulic power steering. Known and used the world over.

Model 35T. Payload of 35 tons (24 cubic yards, struck). 335 to 400 HP and hydraulic torque converter with built-in down-hill retarding. Heavy-duty 4-speed transmission.

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D-125

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Versatility and mobility — the ability to do *many* jobs and the ability to get *to* any job quickly and easily — are big reasons for the success and acceptance of rubber-tired tractor-shovels at pits and plants. Cleaner operations are also an important factor in favor of this rubber-tired equipment, as it doesn't chew up the ground and travel surfaces or raise dust like crawler tracks. And among rubber-tired tractor-shovels, none can match the versatility, mobility and productive capacity of the three new 4-wheel-drive "PAYLOADER" models, size for size. Operators of both underground and open pit mines, as well as processors and smelters, praise their effectiveness for loading cars and trucks . . . charging hoppers . . . feeding conveyors, handling tailings . . . clean-up around power shovels . . . maintaining haul roads . . . stockpiling . . . spotting railroad cars and general drawbar work. They like the more reliable traction . . . easier, faster and safer operation . . . increased digging power . . . greater carrying capacity . . . and other outstanding improvements found in these new models.

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No-stop power-shift transmissions can make ALL shifts on-the-go, under full engine speed. No stopping for RANGE SHIFTS . . . no "clutching".

Powerful 40° bucket pry-out, break-out action — Rugged planetary final drives — Power steering — 4-wheel power brakes.

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- ☐ HO (2¼ yd. payload, 1¾ yd. struck)
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Name _____

Title _____

Company _____

Street _____

City _____

State _____

38

Washington (*Continued*)

mining district three miles west of Omak. Diamond drilling has disclosed ore with an indicated value of several million dollars, said Mrs. W. E. Sherman. One hole showed a width of about 16 ft of lead-silver-zinc ore in fissure vein structure and another penetrated 27 ft of ore, Mrs. Sherman said. Sludge samples for wider zone showed 38 oz of Ag, 12.6% Pb, 22.1% Zn and 1.46% Cu worth approximately $148 a ton, she said. Work on shaft began last month.

North Star Uranium, Inc., shipped its first 54 tons for processing to Salt Lake City late in December. Ore, mined from Lehmbecker lease in Mount Spokane district, is expected to assay about 0.30%.

Comstock Mine, Newport, has been reopened and about 500 tons silver-lead ore stockpiled for shipment to Bunker Hill smelter. Comstock, idle for 15 years, is among claims located in 1890's. R. C. McKelvie, Spokane, has taken an option on eight claims, including Comstock, and since September his crews have cleaned tunnels, built ore bins and begun development work.

Pend Oreille Mines and Metals Co. reported a profit of $440,473 before depreciation, depletion and income taxes for first nine months 1956. Total of 433,192 tons of ore was milled, compared with 500,000 tons in all of 1955. Revenue from concentrates totaled $2,135,523. Income included a dividend of $177,055 from the subsidiary, Reeves MacDonald Mines, Ltd.

Jens Jensen, president, Pend Oreille, said shortage of underground miners in Metaline district hampered company efforts to open known ore reserves. But a development program has otherwise proceeded satisfactorily and will be continued in 1957.

Jensen estimated firm could have doubled its production with adequate manpower.

Clayloon Uranium Mining Co. has resumed exploratory drilling on Dawn Uranium and Oil Company's Weiber-Wisemore lease in Mount Spokane district under a one-year operating agreement. Proceeds from any production will be divided equally.

Lease, about three miles north of Daybreak Mine, was site of first drilling by Dawn. Seven holes, drilled to depths of 350 ft, showed autunite cores at 200, 250 and 300 ft.

Clayloon also plans to continue exploratory work throughout the winter, whenever weather permits, on 5,000 acres of its own lease holdings lying mostly in Stevens County.

Sunny Peak Mining Co., Spokane, has reopened old Mineral Hill Mine, near Conconcully in Okanogan County. Crew removed large tonnage of overburden from mouth of tunnel and installed new timber supports 435 ft into tunnel.

Dale Lanphere, a stockholder, said he had managed to work his way 500 ft farther along the tunnel to the face of the old Frankie Boy copper-gold-silver-lead vein from which ore shipments were made many years ago.

Midnite Mines, Inc., has located nine radioactive orebodies on Spokane Indian Reservation properties, according to map shown publicly for first time. Map details exploratory drilling by operating firm, Dawn Mining Co., and shows orebodies ranging up to 150-ft wide.

Map is contained in an offering circular issued by 14 stockholders of Midnite Mines, Inc., including locators, John and James LeBret and 12 relatives and close friends who joined in organizing company.

Two of the nine orebodies are on the 120-acre Boyd lease adjoining original Midnite property. Dawn company paid $317,000 for Boyd lease in July.

Circular estimates cost to make operation self-supporting at $5.6-million. Newmont Mining Corp. owns 153,000 shares of Dawn's 300,000 shares and Midnite Mines the remainder. Dawn is developing properties and building uranium processing plant near Ford, with funds advanced by Newmont.

Daybreak Uranium, Inc., will speed operations at its Dahl lease in Mount Spokane district to mine and stockpile about 5000 tons of ore during winter months.

Toe hole drilling with Kennametal Rock Bits

KENNAMETAL* Rock Bits

drill abrasive sandstone 12″ to 14″ per minute

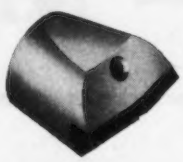
Using Kennametal PX600-3½ and PC600-3 Bits, this contractor gets 150 feet per grind drilling Pocono sandstone, and 8 to 10 regrinds per bit. At drilling speeds of 12″ to 14″ per minute, this means that drilling time is cut to a minimum, his investment in drill bits is low, and bit maintenance is down to rock bottom.

This is typical Kennametal Rock Bit performance in percussion drilling. To provide for varying conditions, Kennametal Rock Bits are available in three styles, all three with special Kennametal grades that stand up under heavy shock and abrasion.

Style PA, or Chisel Bits provide fastest penetration in uniform rock formation. Style PC, or Cross Bits operate without wedging in fissured or ravelly formations. And Style PX, or "X" Bits eliminate rifling and produce uniformly round holes. Bits are available in sizes up to 5″ diameter.

Why not discuss your drilling problems with a Kennametal representative? He will help you select the right style for each of your operations. Or write KENNAMETAL INC., Mining Tool Division, Bedford, Pa. B-5005

*Trademark of a series of hard tungsten and tungsten-titanium carbides.



Style PA

Style PC

Style PX

INDUSTRY AND KENNAMETAL ...Partners in Progress

29
SALES AND SERVICE LOCATIONS

Sales and Service Facilities at Birmingham, Ala.; Los Angeles and San Francisco, Calif.; Denver, Colo.; Washington, D.C.; Kellogg, Idaho; Centralia and Chicago, Ill.; Boston, Mass.; Detroit, Mich., Duluth and Minneapolis, Minn.; Butte, Mont.; St. Louis, Mo.; Carlsbad, N.M.; New York, N. Y.; Cincinnati and Cleveland, Ohio; Forty Fort, Philadelphia and Pittsburgh, Pa.; Knoxville, Tenn.; Dallas and El Paso, Texas; Salt Lake City, Utah; Seattle and Spokane, Wash.; Fairmont and Huntington, W. Va.

Get complete information on rotary air-blast drilling . . . write for Bulletin 153-4

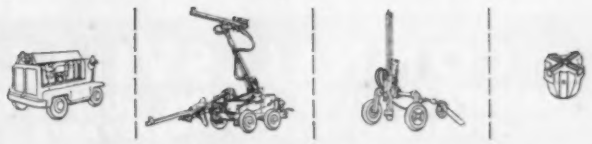
A FAST PORTABLE DRILL FOR BLAST HOLE DRILLING . . . THE *Joy* 225 BLASTAIR

Here's a drill that really gets around . . . as fast as any truck . . . yet punches down holes like the biggest heavy drills. The 225 Blastair operates on the rotary air-blast principle, (continuous pressure cutting, with a continuous blast of compressed air for cleaning) developed and proved by Joy. This faster method of blast hole drilling eliminates lost holes, and drills smooth, parallel-walled holes . . . easier and safer to load. The 225 drills dry . . . eliminates piping layouts or water haulage —operates all year 'round without worry about freezing water lines.

In quarrying, stripping, and large cut-and-fill operations, the 225 has proved to be the answer to drilling problems . . . it may be the answer to your problems. Write to ***Joy Manufacturing Company, Oil Field Drill Division, P.O. Box 35326, Airlawn Station, Dallas 35, Texas.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW 06468-153

JOY **EQUIPMENT FOR CONSTRUCTION . . . MINING . . . QUARRYING**



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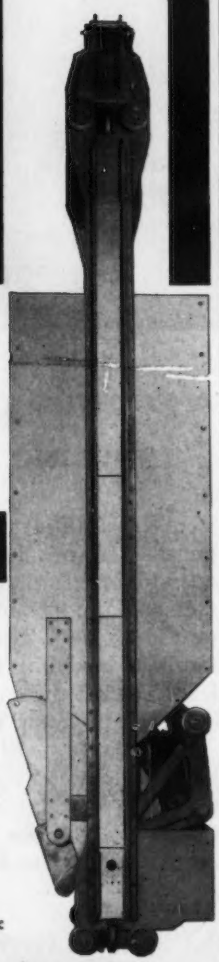

Connellsville Skips are custom-built to meet your particular hoisting requirements with these design features providing economy, safety and speed of operation:

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- Toggle-locked chute prevents skip from discharging while in transit . . . no spillage.
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"Serving the Mining Industry Since 1901"

Washington *(Continued)*

Daybreak Uranium, Inc., will speed operations at its Dahl lease in Mount Spokane district to mine and stockpile about 5000 tons of ore during winter months.

Daybreak plans discussions with Boothby Mining properties, Seattle, to discuss financing 100 tpd upgrading plant that would cost an estimated $50,000.

Painted Desert Uranium and Oil Co. has leased a 17-claim tungsten property southeast of Lake Coeur d' Alene, Idaho, from two prospectors who were unwittingly aided in their search by a uranium hunter in an airplane. Locators are Edgar O. Oehrling, a veteran Spokane prospector, and Arno W. Mollenhauer, Spokane apartment owner.

They were prospecting in old Elk silver-lead district near the lake when they noticed a plane circling overhead. Soon two men in a jeep came down a mining road and said they had located uranium from the plane. Informed the area already was staked, they left.

Oehrling and Mollenhauer checked their claims for uranium; but found only small radioactivity. In ultraviolet light, however, one of their new road cuts glowed in the dark. It proved to be scheelite.

WYOMING

Intermountain Chemical Co., Westvaco, reported it mined 610,000 tons of trona in southwestern Wyoming during 1956, an increase of 40,000 tons over 1955.

Firm said it spent more than $1-million in 1956 to sink a new shaft and make other improvements. Intermountain also said it planned additional large expenditures in 1957 to enlarge its facilities.

Gas Hills Uranium Co. is mining from 60 to 70 tpd from underground mine in western Gas Hills area. President Cotter Ferguson said underground water is giving considerable trouble—freezing in the stockpiled ore on the surface and not drying out.

Gas Hills is also conducting extensive drilling and exploration on its Sagebrush claims adjoining the mine.

Lawrence J. Bergsten, Lander, and Oakland, Calif., has won a court order terminating Mountain Mesa Uranium Corp.'s lease on his group of uranium claims in Crooks Gap area of Fremont County.

Phelps Dodge Corp., operators of extensive uranium properties in Crooks Gap and other sections of Fremont County has opened an office in Lander. It will serve as headquarters for its operations in the area.

Eldon Clark will head the office.

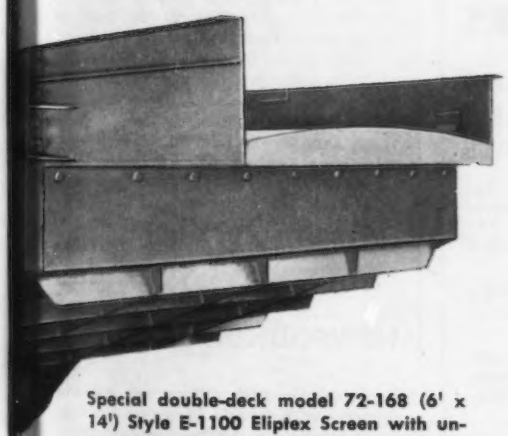
Clark also announced that Phelps-Dodge has shut down its drilling operations in Crooks Gap for the winter. Information gained during past summer will be compiled and evaluated during winter. He said information obtained from drilling will be used to determine type and extent of work to be done next spring.

Columbia-Geneva Steel division of United States Steel Corp. has entered into

ADAPTABLE

Effective Dewaterizing

New, simpler, more rugged design of the Eliptex Screen is shown in this photograph of the standard double-deck model 60-240 (5' x 20') Style E- 13.



Special double-deck model 72-168 (6' x 14') Style E-1100 Eliptex Screen with underslung vibrator. This model is especially suited to installations where headroom is a problem.

-ROBINS

CONNECTICUT

INDUSTRY CASE HISTORY

Headroom Problem Solved by Eliptex Screens

Headroom limitations set up a difficult problem in the installation of Eliptex Screens at the United Pocahontas Coal Company mine in Crumpler, West Virginia. In a normal arrangement, the two screens would not fit into the existing tipple under the shaker screen and feed to the existing equipment.

To overcome this difficulty, Hewitt-Robins revised their standard Eliptex Screens so that the vibrator could be underslung. Thus, Hewitt-Robins engineering was again able to demonstrate the versatility and adaptability of the Eliptex Screen.

The two screens are mounted directly beneath a shaker screen with 1½" openings and operate in tandem to perform a fine screening job before a coal washer. The top deck takes "overs" directly to the washer; the bottom deck acts as a feeder with a long discharge lip, dumping the fines onto a conveyor. At this point, the fines are mixed with washed fine coal and loaded into railroad cars.

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INDUSTRIAL SUPPLY DISTRIBUTOR
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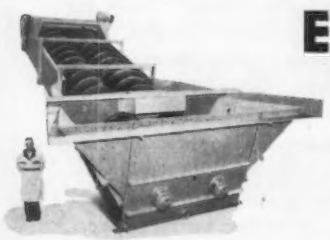
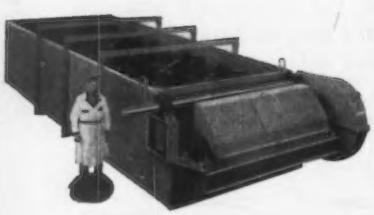


EAGLE WASHERS AND CLASSIFIERS

FOR ORE AND NON-METALLIC MINERALS



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FINE MATERIAL WASHERS

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BREAKER BALLS & PILE HAMMERS.

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Ask for Bulletin 1151

Wyoming *(Continued)*

a contract with Centennial Development Co., Eureka, Utah, for extensive exploratory development of its iron ore reserves in Fremont County.

Centennial Development will excavate adit and horizontal shaft into Columbia-Geneva's deposits on a mountain north and east of Atlantic City.

Columbia-Geneva officials met recently with Wyoming Natural Resource board and Gov. Milward L. Simpson to discuss possibility of wide-scale development of the low-grade deposits as an alternate supply for its blast furnace at Provo, Utah.

Veca Minerals Co., Riverton, has **opened uranium stripping operation** in East Gas Hills area that is expected to mine several hundred thousand tons of ore, according to S. J. Stanbury, one of the owners.

IN CANADA

Canada is now the world's leading producer of five mineral products. It is expected that within two years the country will jump into top place as a producer of uranium, with annual production worth $350- to $400-million.

Country is the world's leading producer of nickel, asbestos, platinum, calcium and nepheline syenite and ranks second in production of aluminum, gold, zinc, titanium ore, magnesium, cobalt, cadmium, and selenium.

Copper production, not top-ranking in the world picture, does occupy top spot in Canada with annual value of $300-million, supplanting the lead of nickel production two years ago.

Likely to be a contender for the first place in a few years is iron ore. Present production, which is steadily increasing, is $175-million annually.

In almost all mineral departments, production has been going up since 1945. Canada's mines in 1956 will produce close to $1.7-billion worth of minerals.

To this must be added petroleum and natural gas to bring total to more than $2-billion.

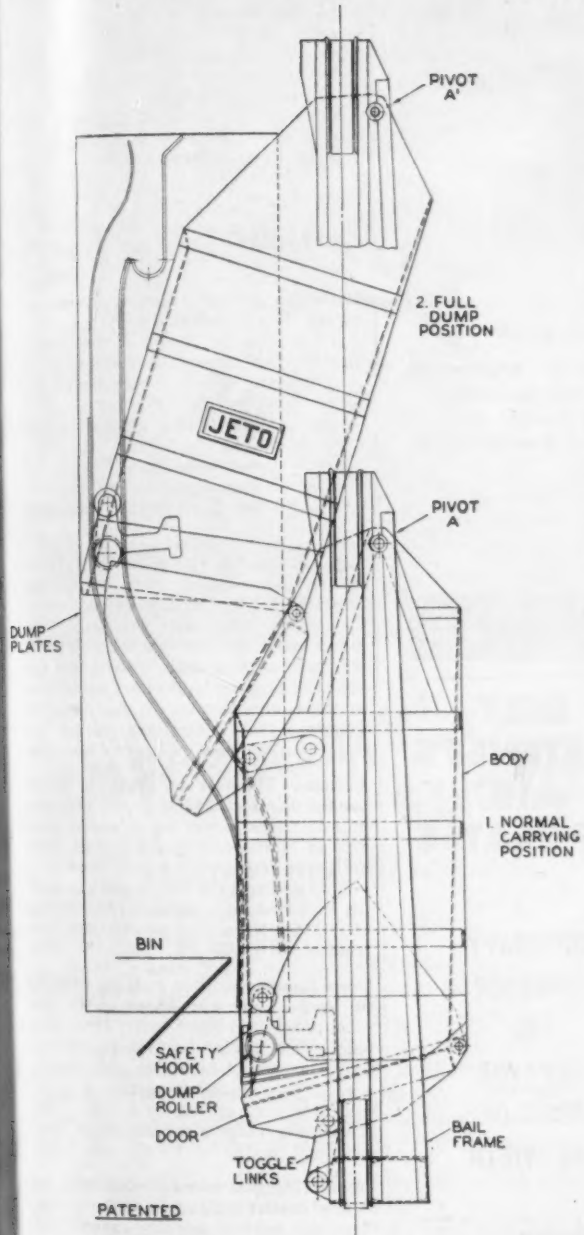
NEWFOUNDLAND

Intensive diamond drilling on asbestos property of Advocate Mines on Burlington Peninsula has outlined approximately 13-million tons grading about $8 per ton. Grade, based on visual core readings is subject to upward revision. Two bulk samples of 600 tons each yielded values of $21.53 and $14.85 per ton.

Total of 12 drills is being employed to outline ore and provide necessary information for open pit mining. Target is to prove up some 75-million tons by next June.

Total iron ore shipped to all markets in 1956 from the Bell Island operations of Dominion Wabana Ore established a new

Lake Shore's "JETO" bottom dump skip dumps 20% faster — HERE'S HOW IT WORKS



This engineer's drawing shows Lake Shore's "Jeto" bottom dump skip; 1. in normal carrying position, 2. in full dump position. The skip body swings outward from the bail frame on pivot point "A" while toggle links open the bottom door.

How the "Jeto" skip is made

The two principal parts of Lake Shore's "Jeto" bottom dump skip are the bail frame and the body of the skip. They move vertically in the shaft guides. When the dump position is reached, the body swings out and the ore is jetisoned. The dumping mechanism consists of a pair of dump plates (or scrolls) mounted at the dumping station, and dumping rollers, safety hook rollers, toggle door release links, all mounted on the skip.

How it works

As the loaded skip moves into the scrolls, the safety hooks unlock the body from the bail frame, the dump rollers swing the body outward. With the outward movement of the body, toggle links attached to the skip door and the bail frame open the skip door and the ore is dumped. In full dump position, the door is in line with the back of the skip body, and the ore flows unrestricted from the skip. When the skip moves down, the same mechanism closes the door and swings the skip body back into the bail frame.

Why the "Jeto" reduces ore handling costs

"Jeto's" bottom dump is 20% faster than a Kimberly, means more skip loads per day.

Sticky ore dumps clean every time.

Full weight of skip is on the rope at all times —improves hoisting balance.

Positive door action prevents accidental dumping—safety hooks keep body locked in bail frame until dumping station is reached.

When planning to replace a skip or to sink a new shaft, talk to the people at Lake Shore: Find out how the "Jeto" can reduce ore handling costs in your operation.

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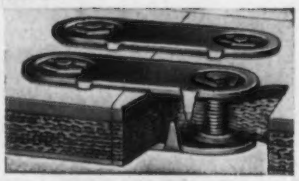

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Newfoundland *(Continued)*

all-time record. It is expected that final tally will amount to 2,750,000 tons, as against the 1955 total of 2,369,177 tons.

Reports from Springdale, state that development during the winter is expected to blossom out next spring in a full scale program of mine construction at nearby Little Bay. Diamond drilling has established deposits of at least 2-million tons of ore running 2.1% Cu.

Shaft will be driven at least 1,000 ft to permit detailed exploration by Atlantic Coast Copper Ltd.

ONTARIO

Kenbridge Nickel Mines, Falconbridge Nickel Mines subsidiary, is deepening shaft at Populus Lake, Kenora area, nickel-copper property to depth of 2,000 ft. Originally it had been planned to open a level at 1,000 ft before resuming deepening. Change in plans follow drilling in which best results were obtained at 2,000-ft depth. Substantial orebody has already been partially outlined on the 350 and 500-ft horizons by some 2600 ft of laterals.

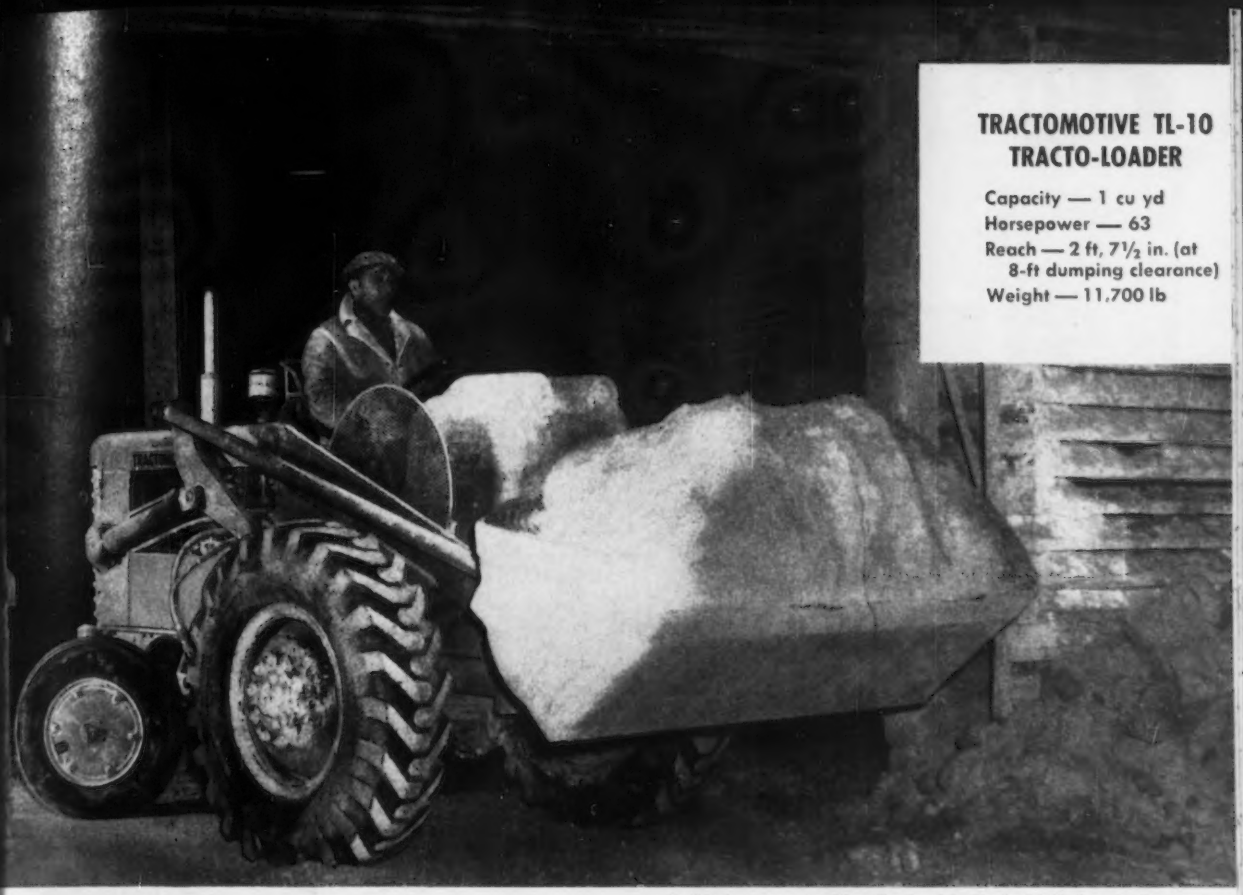
Construction has started on new $12.5-million concentrating plant by International Nickel Co. of Canada adjacent to its Levack mine near Sudbury. Plant, scheduled to go into operation in 1958, will have a rated capacity of 6,000 tpd. Mill will produce both nickel and copper sulphide concentrates. Nickel will be treated at Inco's Coniston smelter and copper at company's Copper Cliff plant.

Kirkland Minerals is engaged in expanded diamond drilling to test extension of mineralized zones on its nickel prospect in Sothman Twp. In all, six drills are to be employed. Current work is to join up two zones in which previous drilling indicated an estimated 150,000 tons of 1.25% Ni and some 500,000 tons grading just under 1%.

Deep diamond drilling is being resumed by Roche Long Lac Mines on its uranium prospect in Blind River. Three deep holes were drilled previously, two of which intersected favorable zone. Values were a little under ore grade. It is intended to put one hole to at least 2,000 ft and then wedge it for additional intersections.

Falconbridge has resumed steel work on its new smelter building in Sudbury area. Plant will provide smelting capacity for a proposed annual output of 55-million lb of nickel, in addition to more than half that amount in copper together with cobalt and precious metals. Present output rate is from 40- to 43-million lb yearly from the old plant.

Algom Uranium Mines has both its Nordic and Quirke mines in production. Quirke mine started milling in September and the Nordic mine commenced milling mid-December 1956. Both mills have a capacity of 3,000 tpd. To mid-December



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Capacity — 1 cu yd
Horsepower — 63
Reach — 2 ft, 7½ in. (at 8-ft dumping clearance)
Weight — 11,700 lb

. . . in this low carry position the load is "tucked in" close to the cowl.

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You can scoop up a heaping load and carry it low without spilling with the Tractomotive tip-back bucket. In this low carry position, the load is "tucked in" close to the cowl for better balance and visibility . . . easier maneuvering. Short turning radius enables the TL-10 to turn from a 9-ft aisle into a 10-ft bin without jockeying. It easily loads into high dump bodies or hoppers . . . and there's *extra long reach* because tires do not extend ahead of cowl. But these are just a few of many TL-10 advantages.

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Make an appointment for a demonstration. See how these big-production features will help you increase output.

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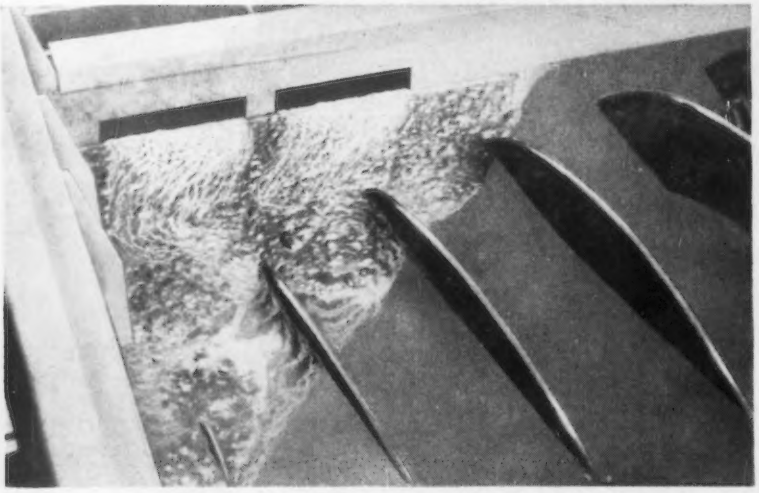

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Ontario *(Continued)*

the Quirke mine had shipped a total of 99,000 lb uranium oxide. Capacity output is expected to be around 160,000 lb monthly.

Lake Shore Mines, veteran Kirkland Lake gold producer (2500 tpd), has agreed to mill all ore from Wright-Hargreaves Mines located in the same camp. Current tonnage rate being handled by each mine (490 tpd for Wright and 590 tons for Lake Shore) will remain unchanged under plan. Program, which will result in savings to both companies, is planned to start in April.

Pronto Uranium Mines, first uranium producer in the Blind River area, discloses ore reserves amount to some 4.0-million tons averaging 0.132% uranium oxide. This is sufficient for more than eight years' operation at current milling rate of 1,200 tpd. Further mill expansion is to be carried out and a rate of 1,500 tpd will be attained by April.

Northspan Uranium Mines is speeding construction at its three uranium mines in Blind River. Lake Nordic mill (4,000 tpd) is scheduled to start production in July, Spanish American (2,000 tpd) in August, and Panel (3,000 tpd) in September. Two shafts are being sunk at both the Nordic and Spanish American, while two shafts have been completed at Panel. Shaft has also been completed at Buckles mine, where a relatively small tonnage deposit has been outlined. Ore from this mine will be treated at the Spanish mill.

Steep Rock Iron Mines has set a production objective of 3.5-million tons iron ore for 1957 from Steep Rock Lake. During 1956 shipping season a record 3,314,148 long tons was produced, compared with 2,264,036 tons in 1955. It is planned to reach an annual output rate of 5.5-million tons by 1961.

QUEBEC

Total value of mineral production in the Province in 1956 will reach $440-million —about $55-million over 1955, according to prediction made by W. M. Cottingham, minister of mines.

Quemont Mining Corp. is opening new ore on deep levels at mine in Rouyn-Noranda area. New Block of six levels are being developed from 2670 to 3420 ft. First ore was encountered on 2820 and 3270 levels, while a drive is being pushed on 2970 to reach projected ore. On 2820, estimated 1200 ton per vertical foot averages 0.17 oz Au, 1.02 oz Ag, 1.1% Cu and 2.48% Zn. On the 3270 level, estimated 950 ton per vertical ft averages 0.26 oz Au, 0.86 oz Ag, 0.98% Cu and 1.94% Zn.

Duvan Copper Co. is considering treatment plans for copper ore from its property some eight miles southwest of Normetal. Two methods are available. One is custom concentration at Beattie-Du-

Here is a new technique for recovery of values from tailings

A new economical method for additional recovery was developed in 1954 at this Mesabi Range iron ore beneficiation plant by the use of Krebs Cyclones. A battery of 10 Model EE20-9B integral two stage Krebs Cyclones* handles 5840 gpm (281tph) with the primary overflow rejecting paint slime and the secondary overflow rejecting fine sizes high in silica and low in iron. This is an exceptionally sharp split. Upgrading from 20.75% Fe to 34.72% Fe into crystalline sizes makes an ideal feed for the subsequent concentration to required grade.

This recovery technique has now been adopted by 14 other iron plants throughout the world and has also been applied to tailings from plants handling ores of chrome, manganese, copper, lead-zinc, tin, tungsten, gold-silver.

We invite you to consult us on the advantages of Krebs Cyclones to your operations.

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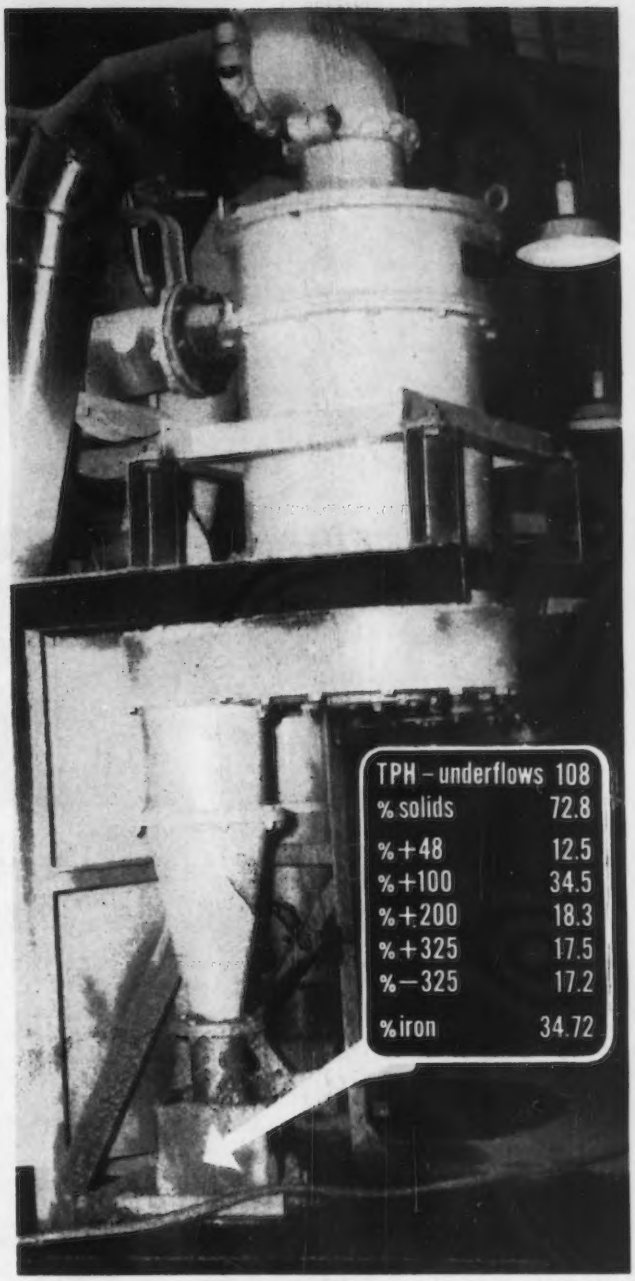

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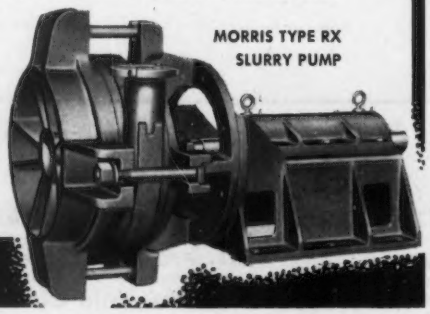


MORRIS CENTRIFUGAL PUMPS

Quebec *(Continued)*

quesne mill some 40 miles distant with subsequent treatment of copper concentrates at Noranda. Second is erection of 350 tpd mill at the property.

No. 6 ore zone at Lyndhurst Mining Co.'s copper property some 30 miles north of Noranda is responding favorably to development. On the 425-ft or third level, zone has been opened for more than 210 ft of which 192 ft has averaged around 2.25% Cu. Drilling has indicated a width of 25 ft for this length.

Bouzan Mines is preparing a new diamond drilling program at its main property in Chibougamau district. At least four diamond drills are to be employed to test westerly extension of the hanging wall copper zone encountered in drilling on the mainland. Present program will be carried out from the ice of Dore Lake.

Opemiska Copper Mines has embarked on a major mill expansion program at its copper producing property in Chibougamau area. Program, in two stages, is designed to more than triple present production capacity of 800 tpd. First increase to 1,600 tpd is expected to be completed by the end of current year and final boost to 2,400 tpd by late 1958. Ore reserves have been increased substantially during past year and are more than double the 2,244,420 tons, 4.08% Cu estimated at end of 1955.

Surface diamond drilling at the Chibougamau property of Copper Rand Chibougamau Mines has indicated a new zone. One hole, put down from an island in Dore Lake about 1600 ft south of No. 2 shaft, cut two sections at vertical depth of 700 ft. One section averaged 1.65% Cu over 16 ft, and the other 2.94% over 11 ft.

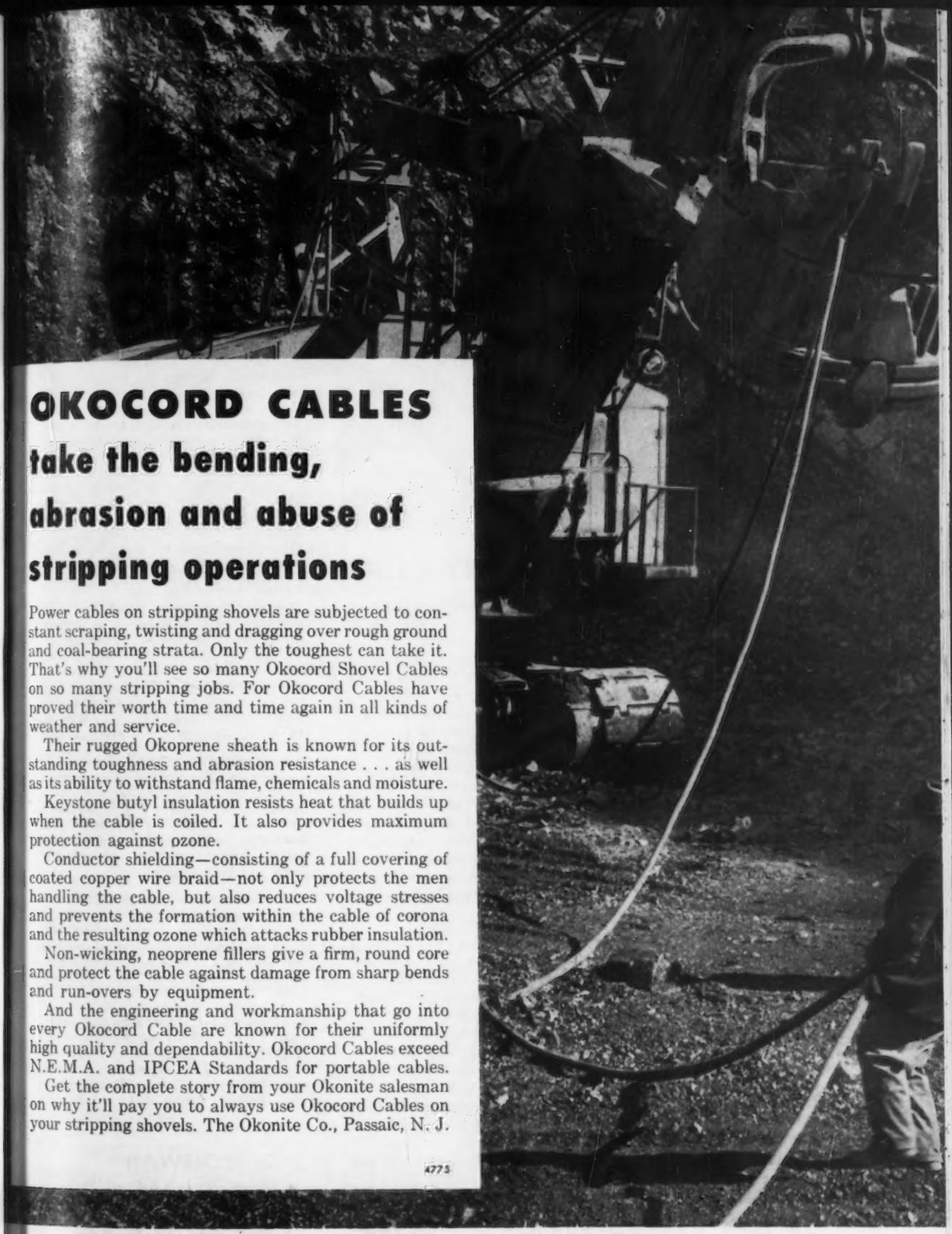
An agreement regarding iron ore mining in Eastern section of Quebec has been reached by the firms Aconic Mining Corporation, Montreal (who hold mining rights), Ferguson Wild & Co., London, the U.S. firm Franz Samuels & Co., and German firm Kloeckner & Co., Duisburg.

Kloeckner will deliver an ore sorting and concentrating plant with an annual capacity of 1-million ton concentrate. Project, which will be completed by 1959, is valued at $10-million. Some 80% of construction cost will be paid by delivery of iron ore over a period of five years.

On top of the 267,000 tons which will be delivered free, Kloeckner will buy another 483,000 tons iron ore per year at a price of $7.47 per ton f.o.b. Natashkwan.

MANITOBA

New ore plugs at Moak and Thompson mines, 400 miles north of Winnipeg are bigger and better than originally expected by International Nickel Co. of Canada Ltd. according to non-company sources. Company's production plans are now able to embrace mining and smelting—



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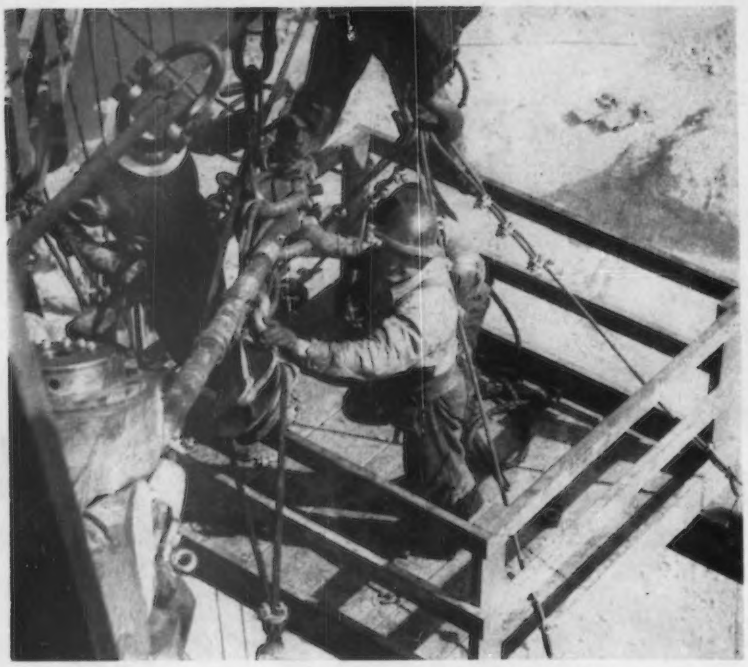

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Manitoba *(Continued)*

and possibly refining by 1960—at 8,000 to 12,000 tpd, with nickel output from the $175-million venture in north central Manitoba expected to exceed 70-million lb a year.

Grade is turning out to be 1.5% Ni, especially on the Moak Lake property, which started in by showing 0.5-0.6% Ni. Ore production from both operations is to be averaged for a grade slightly better than 1%.

Moak orebody has been revealed in the last month as an impressive plug 4,000- to 5,000-ft long and up to 800-ft wide, and is still open at the bottom where drilling is at 2100 ft, working from 1300-underground shaft level.

Thompson orebody, 18 miles away, with no shaft work undertaken yet, remains wide open in every direction with ore showing in all drill holes over a length of 15,000 ft and up to 1500-ft down, ranging in width from 10 to 200 ft. Total strip, slated for continuing intensive exploration, is 78 miles long and five miles across.

Not the slightest trace of surface ore shows in the entire area. Inco has spent $10-million in exploration since 1946, depending largely upon airborne geophysical surveying (as much as 24,000 miles a year) and delineating suspected anomalies with ground survey follow-up.

Montgary Explorations reports that concentration tests on Bernic Lake lithium ore indicate a satisfactory grade of feldspar and quartz concentrates can be produced. Recovery of these byproducts is being planned. At Bernic Lake shaft sinking is progressing and power is expected to be made available early in 1957.

New Manitoba Gold Mines reports good progress in shaft sinking at its copper-nickel property near Cat Lake. First level station has been cut at 175 ft and sinking is now progressing to the second level at 350. Permanent hoist and compressor building of steel and concrete block has been completed.

Lee Gordon Mines reports a drill contract has been let for 2,000 ft of drilling on its Vamp Lake copper prospect in northern Manitoba. Geophysical surveys will also be carried out. Copper values have been found over three separate zones.

Lynwatin Nickel and its subsidiary company, Evelynn Nickel has commenced an electromagnetic survey on its properties in the Lynn Lake. Company controls some 88 claims adjoining Sherritt Gordon's property on the east.

SASKATCHEWAN

Canada's first potash industry is in sight. Construction of a refinery to cost $20-million will begin next year at Patience Lake site of Potash Co. of America, 10 miles east of Saskatoon in central part of Saskatchewan.

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NEW ALEMITE "BIG-A" PORTABLE BUCKET PUMP

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  1. Light or heavy lubricants.
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- **Easiest to carry!** Oval shape prevents bucket from bumping leg.
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- **New foot valve design assures full pressure** on every stroke.
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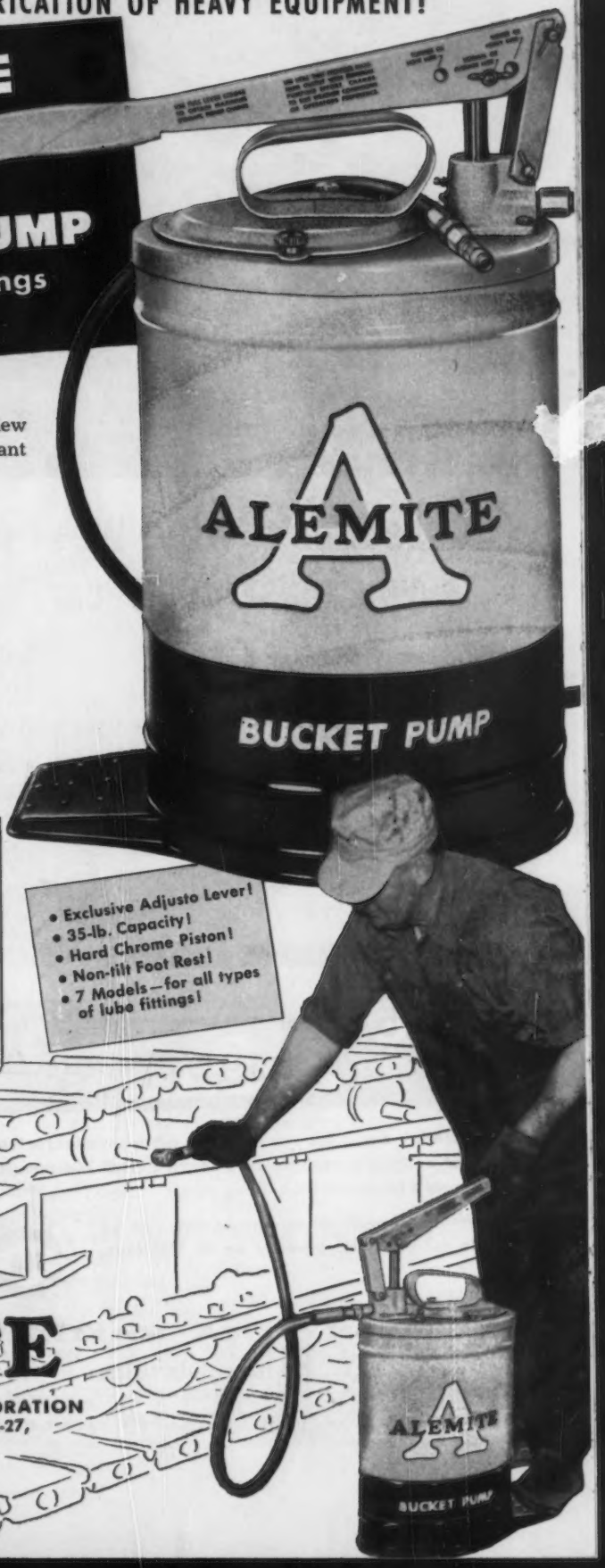

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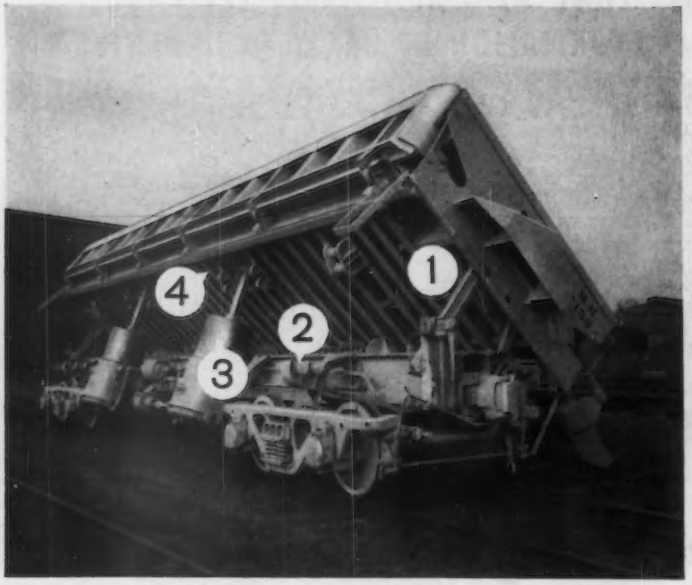

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Saskatchewan *(Continued)*

T. L. Carey, resident plant manager, said Stearns-Roger Mfg. Co., Denver, Colo., are working on mill engineering details. He added that actual construction of the refinery was expected to get underway early in the summer of 1957, with production scheduled for October 1958.

Capacity of the refinery would be from 4,000 to 4,500 tpd.

Potash Co. of America currently is shaft sinking on this potash property. Work of sinking the concrete-lined shaft through refrigerated formations has proceeded steadily through summer and fall and 910 ft had been reached late in December. Potash beds to be mined lie at a depth of about 3400 ft. This shaft-sinking phase of the work is estimated to cost $3-million.

Company has a large surface plant at Patience Lake. Other companies—a total of 12—also are active in the province in exploration but have not yet (with one exception) reached shaft-sinking operations. They hold acreages in the 340-mile long potash belt which extends across central Saskatchewan (possibly the world's largest ore reserves) estimated by the Saskatchewan Department of Mineral Resources at 100-billion tons.

Continental Potash Corp. (formerly Western Potash Corp.) was the first to start shaft-sinking. Its shaft, near the town of Unity in west-central Saskatchewan, reached a depth of 1170 ft a year ago when work ceased pending refinancing.

Potash Co. of America also has extensive holdings in the Quill Lake area, 100 miles east of Saskatoon, where it is known that the deposits of both carnallite and sylvite are thick and extensive. According to a statement early in December by G. F. Coope, president, development was not planned on this property until warranted by markets.

Saskatoon venture, on the other hand, he said, was being developed complementary to the Carlsbad, N.M. holdings, partly to maintain company's long-range reserves, partly because of favorable tax treatment in establishing mining ventures in Canada.

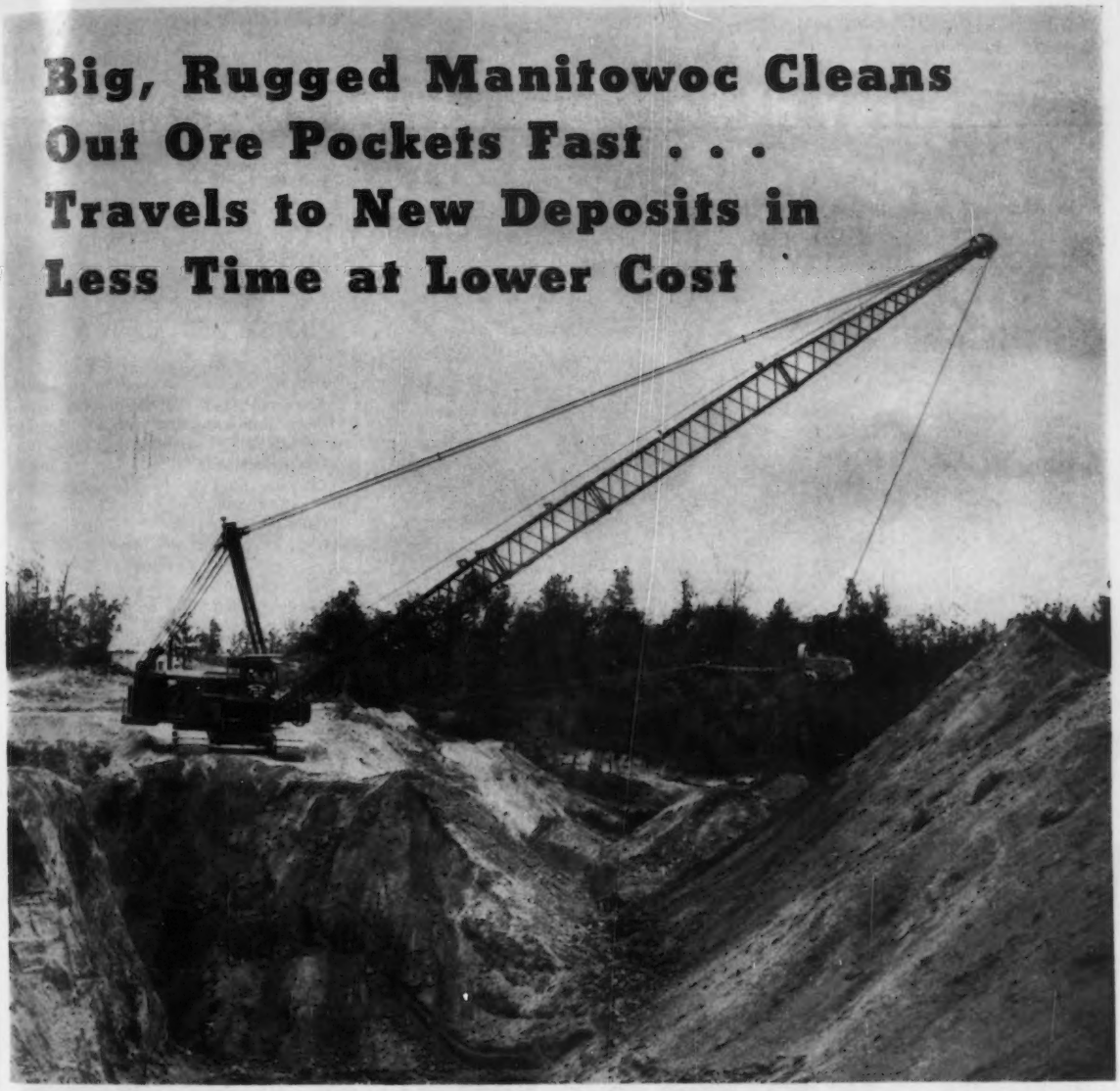
Earlier Coope had said in Saskatoon that success of this first Canadian venture was not yet assured. Attempts to mine the ore at 3,000 ft had not been successful in Canada before. Refrigeration of the shaft walls to prevent cave-ins was succeeding quite well. Area around the 16-ft shaft had been frozen by drilling a ring of 28 holes to 3400 ft, and installing refrigeration pipes and ammonia compressors with a capacity of 800 tpd of ice.

Saskatchewan's potash occurs as potassium chloride accompanied by sodium chloride.

Current holdings of some of the larger companies include:

- Campana Ltd., 100,000 acres (at 1½c per acre over 6 months for rental with no work requirements)
- General Petroleums Ltd., 150,000 acres withdrawal
- Duval Sulphur & Potash, 500,000 acres withdrawal

Big, Rugged Manitowoc Cleans Out Ore Pockets Fast . . . Travels to New Deposits in Less Time at Lower Cost



For big production stripping and fast mobility between isolated ore pockets, Shook and Fletcher Supply Co. of Birmingham find that it's hard to beat a Manitowoc Model 4500. This unit is stripping 40′ to 100′ of overburden uncovering 5′ to 30′ of iron ore seams. Equipped with a 4-yd. bucket on a 140′ boom, the 4500 moves better than 8,000 yards of material every 24 hours working in two 10-hour shifts.

The Model 4500 is ideal for mining operations requiring frequent machine moves every shift. With a single Diesel power package you need no electric power hook-up . . . no restrictive power cables. The 4500 travels anywhere you need it. Long or short moves are economical to make—require no expensive road preparation. And on the extra-long hauls this unit can be moved by rail or highway and reassembled in days instead of weeks.

By eliminating the series of independent electric motors, power is utilized more efficiently. In addition to the elimination of several electric motors, generators and control boards, thousands of electric wires and connectors are omitted — there's no power-robbing deadweight to lug around. Operation and maintenance are simple; only routine care by your regular mechanics is needed.

Responsive air controls and smooth torque converter power make the Manitowoc 4500 one of the easiest large machines to operate. You'll get day-long efficiency — top production from every operator on your payroll.

Demand for the 4500 is at a new high. See your Manitowoc distributor *now* for delivery information and machine specifications.

MANITOWOC ENGINEERING CORP.
MANITOWOC, WIS.

MANITOWOC 4500

Draglines —

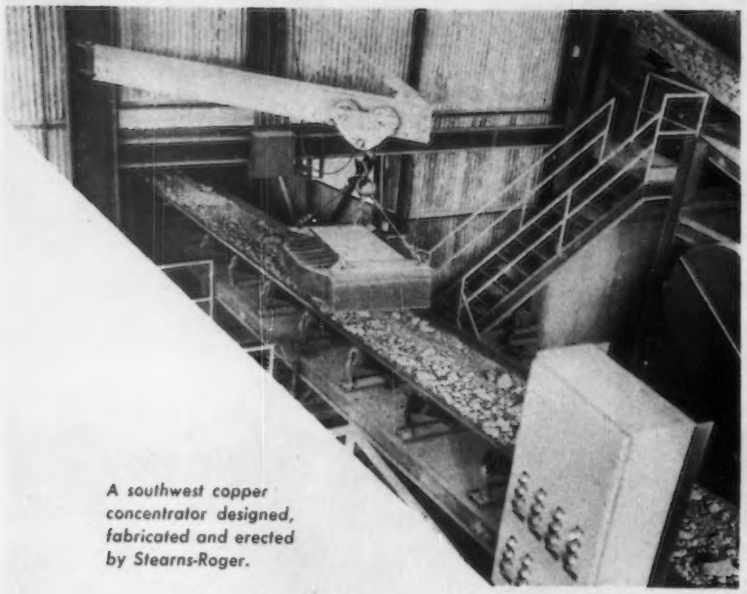
4-yd. to 6-yd.; 120′ to 140′ booms.

Shovels —

4-yd. to 5½-yd.; 40′ to 60′ booms.

MANITOWOC
SHOVELS 1-5½ YD. Speed Crane CRANES 20-100 TON

WHAT EVERY NEW PLANT NEEDS



A southwest copper concentrator designed, fabricated and erected by Stearns-Roger.

Starting with the initial plans for a new plant, sound engineering coupled with a complete design, manufacturing, and erection service insures completion of the project in the shortest possible time. Stearns-Roger has an enviable record for completion on schedule.

WHEN YOU BUILD

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THE STEARNS-ROGER MFG. CO. DENVER, COLORADO

DENVER, SALT LAKE CITY, HOUSTON, EL PASO

STEARNS-ROGER ENGINEERING COMPANY, LTD., CALGARY

Saskatchewan *(Continued)*

International Minerals and Chemical Corp., 600,000 acres withdrawal

Potash Co. of America, 200,000 acres permit (at 5c per acre rental for 3 years and $60,000 work requirements first year, $80,000 second and third years)

U. S. Potash Co., 600,000 acres withdrawal

Continental Potash Corp., 100,000 acres permit

BRITISH COLUMBIA

Value of mineral production in British Columbia for year 1956 is estimated at $189-million compared with a final figure of $174,710,606 for 1955.

Estimated 1956 values for the major items and for groups of minor items with 1955 figures in brackets are:

Gold (lode and placer), $6.8-million ($8,587,920); silver, $8.5-million ($6,942,113); copper, $17-million ($16,932,549); lead, $46-million ($45,161,245); zinc, $59-million ($52,048,909); iron and tungsten, $8.8-million ($8,689,723); by-product metals (includes antimony, bismuth, cadmium, indium, and tin), $5.2-million ($4,245,914); industrial minerals (includes asbestos, gypsum, sulphur and others), $10.4-million ($7,798,098); structural materials (includes clay products, lime, limestone and cement, rock and building stone, sand and gravel), $17-million ($15,299,254); fuels (includes coal, oil, and gas), $10-million ($9,004,631).

A $2-million steel ingot plant with 100,000 tons capacity will begin rising almost immediately on 140-acre Twigg Island in the mouth of the Fraser River near Vancouver, B. C. as the first major step towards construction of a steel smelter in British Columbia by Western Canada Steel Ltd.

Woodgreen Copper Mines Ltd. (formerly known as Surety Oils and Minerals) has given area a boost with the news that its 1000-ton mill, which starts operating this month, will very likely be enlarged to 2,000-ton capacity. Ore reserves may exceed 5-million tons, and it expected to average 1% Cu with important values in gold and silver.

Bethlehem Copper Corp. (55% AS&R) reports that its overall ore reserve is now estimated to be 81-million tons. Drilling over last four months has added 10-million tons at the Jersey zone, now estimated to contain 56-million tons, averaging 0.71% Cu of which 37.5-million tons average 0.78% Cu. Remaining 25-million tons are contained in Iona Zone.

Cowichan Copper Co. Ltd. will make decision on a mill within next three to six months, president O. G. MacDonald told shareholders, when company is sure of at least 10 years operation and possibly 20 to 30 years.

Caycuse Copper Co., newest property developed within the O. G. MacDonald

Close-up view of the Cat D9 push-loading a DW21 and scraper near Globe, Ariz. Twin Disc Torque Converter components are standard in the torque converter version of the powerful D9 and D8. Inset (left) shows Roy E. Hale, Superintendent, and Link L. Calvin, Co-owner of Copper State Construction Co.

"Torque converter gives the Cat D9 that extra 'boost' when you need it"

Roy E. Hale, Superintendent, Copper State Construction Co.

When Copper State Construction Co., Mesa, Ariz., took on the contract for building a clover-leaf on U. S. Highway 70 about 20 miles east of Globe, Ariz., it had to move some 70,000 cubic yards of earth—fast and profitably. So one of the powerful Cat D9's (equipped with Twin Disc Torque Converter components) was put on the job, push-loading Cat DW21's and scrapers.

Sizing up the D9's operations, Copper State's Superintendent Roy E. Hale commented: "This D9 is the machine we've been looking for. We like the torque converter drive. It makes the machine operate smoothly and will give it a lot longer life. And when we need that extra 'boost' for tough material, the torque converter gives it to us—with full engine power!"

Little wonder contractors are specifying so many Cat D9 and D8 Tractors with torque converter drive. The torque converter permits the engine to operate at all times in its most efficient speed range . . . it automatically matches output torque to load demands . . . and its fluid connection absorbs those jolts and shocks that cause excessive wear and parts breakage.

Contractors everywhere agree that crawler tractors equipped with torque converter drives mean just this: less maintenance, more production—and greater-than-ever profits! Specify a hydraulic torque converter drive in your next D8 or D9 crawler tractor . . . and don't overlook the advantages of Twin Disc Torque Converter drives in other types of industrial equipment or repowering jobs.

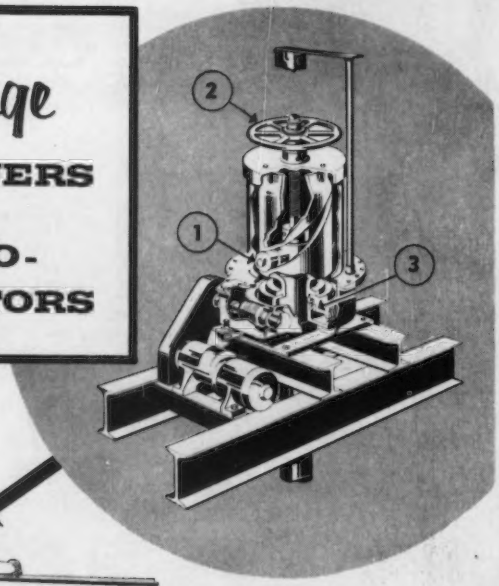
TWIN DISC

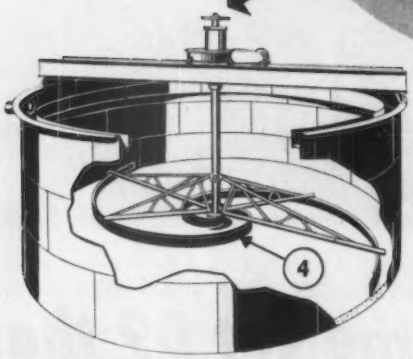
TWIN DISC
Torque Converters

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division) Rockford, Illinois

Hardinge

THICKENERS and HYDRO-SEPARATORS



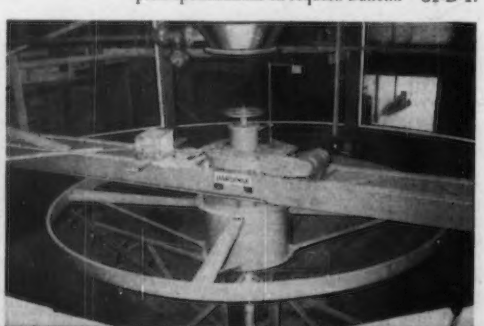


. . . for all clarifying, thickening and de-sliming operations.

For flotation concentrates thickening ahead of filtering—or for tailings disposal or reclamation, Hardinge Thickeners provide:

1. "Auto-Raise" to avoid lost production from overloads.
2. Manual or power raise to supplement "Auto-Raise."
3. Replaceable ring-type ball bearing support for rotating mechanism.
4. Spiral rakes for maximum underflow density.

Also available are froth rakes for froth-free overflow and superposed type tank construction for minimum floor space and building economy. Complete specifications on request. Bulletin 31-D-1.



A 35'-diameter Hardinge Superposed Thickener installation in a Canadian lead-zinc concentrator. The sludge outlet for the upper unit can be seen at the top of the picture. Note froth ring on lower unit.

HARDINGE COMPANY, INCORPORATED

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B. C. *(Continued)*

group, reports that specimen samples from its 62-claim holding covering 3,000 acres, have exceeded 20% Cu with average grade expected to run 5% to 10% Cu.

Findings of Dr. Ernest E. Roots, who headed a 51-man survey party in northern B. C. during summer, have increased belief that the northern area is a treasure house of untapped minerals.

Exploration rush is expected in area in spring when preliminary geological maps, showing what minerals most likely will be found in specific sections of the territory, become available to mining companies and prospectors.

IN AUSTRALIA

Associated smelters of Broken Hill is planning a considerable production increase of lead for export to U. S. Plans provide for large additional smeltering facilities and for installation of modern equipment.

Completion of construction of new acid plant at Rum Jungle, will be followed by increased output of uranium for export to the U.S. and U.K.

Government experts believe that Australian exports of mineral beach sands to U.S. will continue to increase in volume but value increase will be affected by weakening prices.

Electrolytic Zinc Co. of Australasia Ltd. is planning to increase its output of zinc from 104,000 to about 115,000 tons a year. Increase will be accomplished during 1957 and further extensions, at present under initial consideration, would lift the productive capacity to over 140,000 tons a year.

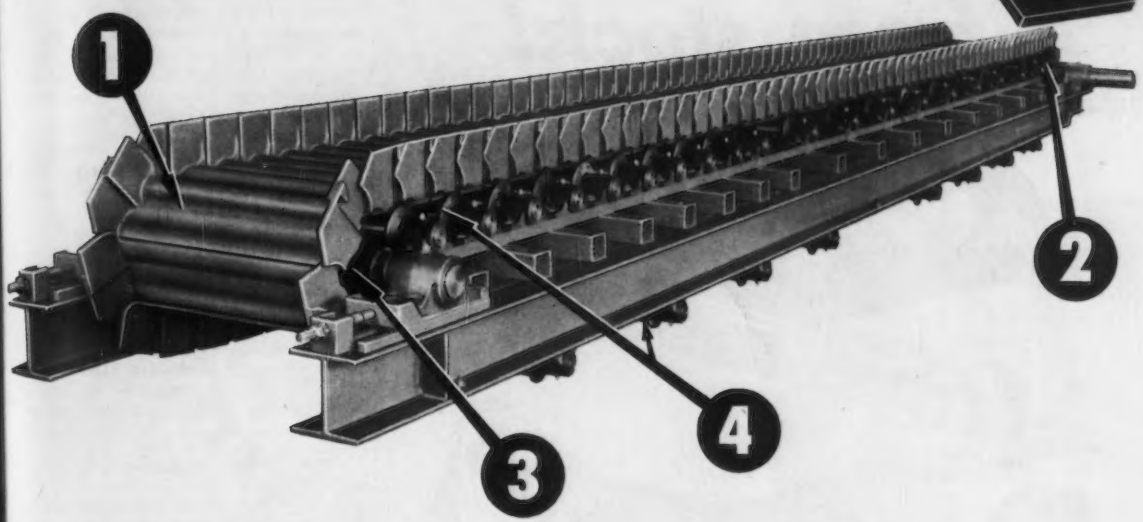
Investigations of manganese deposits in Fiji have failed to discover commercially promising areas. One of the firms taking part in search was Australian-controlled Fiji gold producer, Loloma Gold Mines N.L.

South Alligator Uranium N.L. reported that its 250 East winze in Rockhole adit has encountered pitchblend ore of good grade from 10 to 30 ft below the floor of No. 2 adit. Find is considered to be of promise and a search has been ordered for an extension of this ore.

North Australian Uranium Corp. N.L., in which Atlas Corp. is holding a substantial interest, expects that exploration activities at its Milestone area may take another year to complete. This company is hopeful that the quantity of high-grade ore to be uncovered will be adequate to warrant large-scale mining and treatment operations. Pitchblende has been discovered.

Government delay in reaching a decision on reconstruction of Mt. Isa to Townsville railroad is causing postponement of expansion plans of Mt. Isa Mines Ltd.

WHERE WEAR COUNTS!



TISCO® PAN FEEDERS

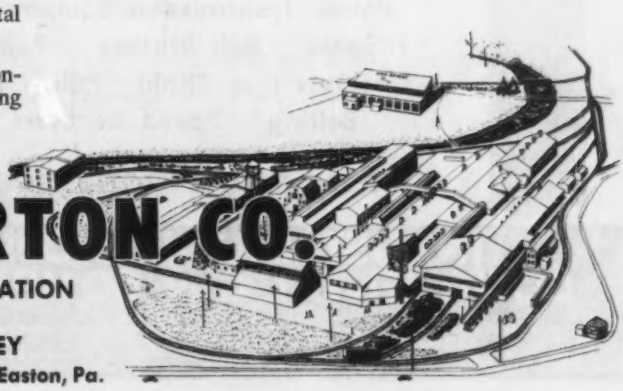
❶ **FEEDER PANS** — Hammered by tons of heavy rocks and ore every minute, but tough TISCO Manganese Chrome Steel pans lick impact and abrasion, outwear ordinary pan feeders 5 to 1.

❷ **HEAD SPROCKETS** — One break-down here flattens production. For dependable durability Manganese Steel does the job.

❸ **IDLERS** — Manganese Steel in this vital part keeps idlers busy, smooth running.

❹ **ROLLERS** — When each roller must continually shake off shocks and abrasion nothing wears like Manganese Steel.

Picture tons of heavy, abrasive material smashing down on this TAYLOR-WHARTON Pan Feeder, month after month without a breakdown. The reason — tough TISCO Manganese Steel soaks up shock and abrasion, keeps production climbing, maintenance down. For further information write to:



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Bucket and Screw Elevators

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CG-5703

INDUSTRIAL DIVISION
CONTINENTAL GIN COMPANY
BIRMINGHAM, ALABAMA

CGC ATLANTA CLEVELAND DALLAS KNOXVILLE MEMPHIS MOBILE NEW YORK 17

Australia *(Continued)*

Plans provide for increase of ore output from 4,000 tons to 13,000 tpd within five years with, perhaps, further expansion of output in later years.

Al Consolidated Gold N.L., a Victorian gold producer, incurred a loss of £A33,391 in its last fiscal year ended Aug. 31. Production totalled 9,571 (13,633) tons for 3,739 (7,173) oz.

Tangalooma Minerals Pty. Ltd. has erected a factory and purchased most of the required equipment. Company hopes to be in full operation by April 1957, and in the meantime is testing additional mineral beach sands leases on both Moreton Bay and Moreton Island.

Throughput and production records have been established by King Island Scheelite Ltd. In its last fiscal year ended October 1956, 1,521 tons of concentrates were produced against previous 1,394 tons. Ore milled was a record at 265,919 tons (262,405) and over-burden removed was also a record at 1,555,035 (1,351,429) tons.

Crescent Rutile N.L. expects the Killcare plant will be in production around May 1957. Testing has confirmed the anticipated tonnage of rutile and 9,000 tons of rutile have already been sold in advance.

Austrak Malay Tin Ltd. is testing possible dredging areas in New England district of New South Wales. Venture is being carried out jointly with Clutha Development Ltd., a subsidiary of Placer Development Ltd.

Several hundred million tons of good bauxite have been blocked out at Cape York by Consolidated Zinc Corp. New company has been formed with British Aluminum to exploit the deposit as soon as power installations can be provided.

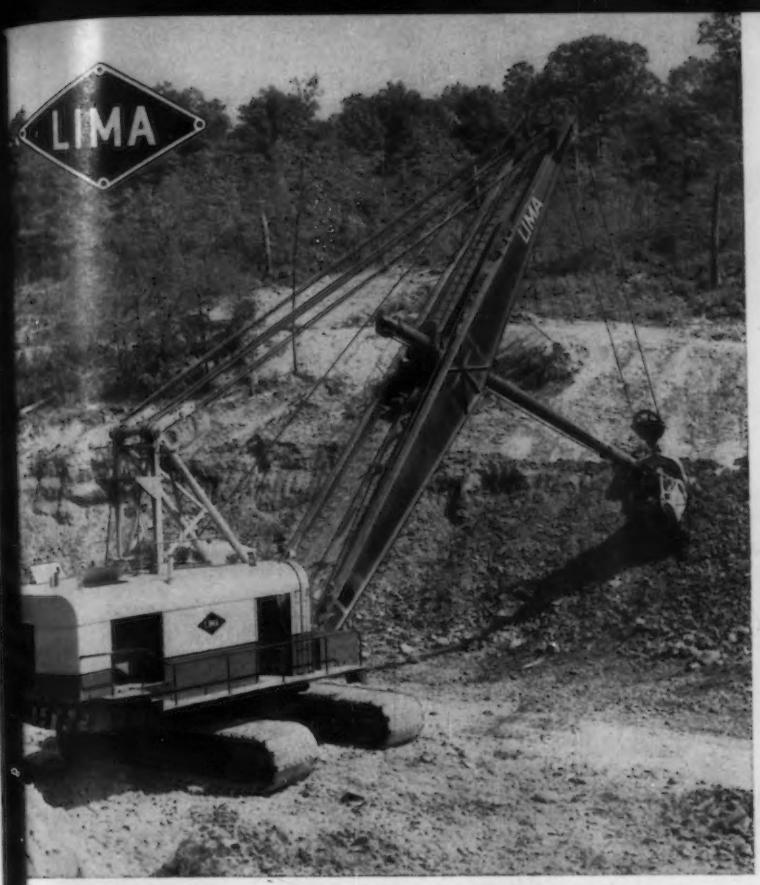
Electrolytic Zinc Co. of Australia Ltd. opened its 55,000 tpy ammonium sulphate plant at Risdon, Tasmania. Plant will make sulphuric acid by contact process from smelter gases and ammonia by gas-reform. These two compounds will then combine to produce ammonium sulphate.

Geologists of Mt. Isa Mines Ltd. (an Australian mining company controlled by American Smelting & Refining Co.) have discovered torbenite over a very considerable area. Several anomalies described as "marked and extensive" have been reported in a number of places outside the find made on Mt. Isa-held areas.

IN LATIN AMERICA

PERU

Contract entered into last June by Minerals, Inc., a Delaware corporation, for the purchase of the Chavin mine in Peru from Frobisher, Ltd. and Guayana



Lima Type 2400 Shovel, equipped with 67-ft. boom, 50-ft dipper handle, and 4-cu yd bucket, stripping coal near New Bethlehem, Pa.

Lima Type 1201 Dragline, with 100-ft. boom, stripping iron ore at Russellville, Ala.

Lima Type 34 Paymaster Shovel loading coal near Denver, Colo.

LIMAS ARE BUILT FROM THE GROUND UP
for high-output stripping and loading

The toughest mantle rock can't stop Limas . . . they strip away overburden with ease, get coal and ore loaded fast. Take a look at some of the features that make the Lima Type 2400 (shown at left above) a favorite:

CRAWLERS are wide and long for greater stability and are steered through air-controlled jaw clutches for ease of handling in close quarters.

TREAD ROLLERS have especially hardened rims to resist wear . . . have piston-ring-type dirt seals and retainers.

MAIN MACHINERY is located so as to hold counterweight to a minimum and to allow faster swing.

DRUMS are mounted in tandem, making it possible to use extra-wide drums . . . a big advantage when operating as a dragline, crane or high-lift shovel, because of the greater cable capacity and longer cable life.

ANTI-FRICTION BEARINGS in the drums hold the brake and clutch surfaces permanently concentric with the center of the shafts, giving smooth, velvety action when they are engaged.

EXTRA-LARGE AIR-CONTROLLED CLUTCHES respond immediately to the slightest movement of the controls.

TORQUE CONVERTER gives greater output, reduces shock loading, prevents engine stall . . . cushioned effect of drive lengthens cable life, reduces machinery maintenance.

PRECISION AIR CONTROL lessens operator fatigue, gives constant feel of the work, means more output with less effort.

Get the full story on the Type 2400 and other profit-making Limas from your nearby Lima distributor, or write Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

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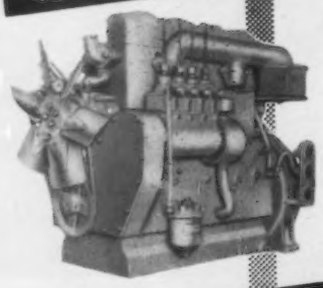
42 HORSEPOWER



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REDUCES TIME LOST TO POWER FAILURES

Built like a big engine, the Model 19 Sheppard masters the wear and tear of heavy-duty service with inherent diesel ruggedness. You pay heavily for work interruptions caused by light-duty engines on heavy-duty work. You can save most of that cost with a switch to Diesel. Write for Sheppard Model 19 engine or generating set data today.

10 to 15 K.W. ELECTRICITY

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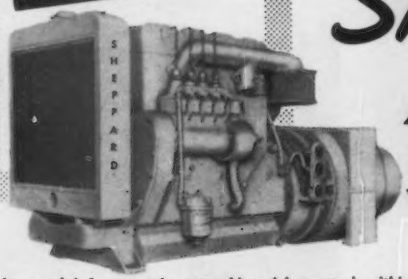

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LOW WEIGHT
COMPACT

Engines and A.C. generating sets shipped from stock within 24 hours
SOLD AND SERVICED by more than 2,000 dealers

FITS INTO SAME SPACE AS YOUR PRESENT ENGINE
17" narrow • 32⅜" short
26" low • *fan-to-flywheel*

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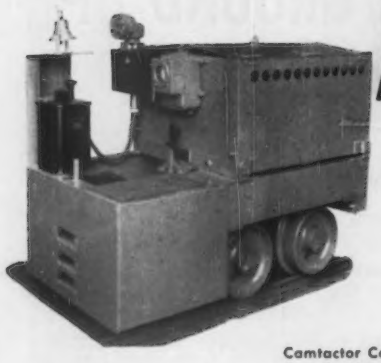

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Camtactor Control Can Be Supplied

Atlas Type J Trammers give you efficient multi-level service with ruggedness and power to meet rigid schedules despite most adverse mine conditions. Their low price is matched by outstanding operating and maintenance economy. Learn today how Atlas can help hold down tonnage costs.

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Peru *(Continued)*

Mines, Ltd., subsidiaries of Ventures, Ltd., will lapse, following announcement by Minerals, Inc. They will not proceed with their plans for Peru.

Purchase price of Chavin and other assets was $2.4-million of which $10,000 was paid on execution of contract. It is understood that Minerals, Inc. requested an extension of installment due Oct. 1, which was granted, but later asked Ventures, Ltd. to release them from contract.

Chavin mine is a high-grade lead-zinc-copper-silver deposit that came into prominence in 1951 when Victor S. Karbowski, a Polish mining engineer and prospector resident in Lima, sold it to Victor Kravachenko for a reported $100,000. Kravachenko carried out the first stages of development before selling it to Consolidated Guayana Mines, Ltd.

Once financing is completed, Ventures Ltd. plans to construct a 5 km aerial tramway from mines, located at 13,200 ft, to site selected for 150-tpd mill, at 7,000 ft. From here, concentrates would be trucked over a highway to be built down San Juan valley connecting with Chincha, on Pan American Highway, and Port of Pisco, a total distance of 90 miles. Present access to mine is over a lengthy route via Oroya and Huancayo, a total of 360 miles from Callao. $1.5-million is estimated investment to place mine on production basis. Work is expected to start in 1957 and should be completed by mid-1958.

Consolidated Guayana Mines has an option on a copper deposit at Tintaya, Department of Cuzco, which surrounds a similar property purchased by Cerro de Pasco Corp., and also on certain properties held jointly with Cerro. Trenching and surface sampling has been completed and diamond drilling is now being carried out.

CHILE

Departamento del Cobre, in a report presented to the government announced that primary copper production during the first eleven months of 1956 reached 443,238 short tons of copper, an increase of over 7% over corresponding months for 1955.

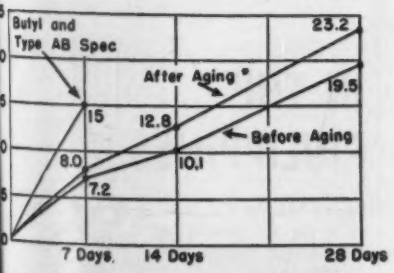
In October last, output of primary copper reached 47,251 short tons, a new monthly high for last 10 years. Departamento estimates that copper production this year will reach 484,000 short tons.

Since the new copper tax came into effect, $102,340,000 have been invested in copper industry by American companies. Of this total, $41.5-million will be invested in Chile and $60.8-million will be spent in U. S. for machinery.

Compania Anglo Lautaro is going ahead with its program to invest $25-million in improving its processes for recovery of sodium nitrate, iodine and other salts by increasing capacity of its solar evaporation process. This company, in October 1956, obtained a $16-million loan from ExIm bank for this purpose.

Up out of harm's way, Anaconda 250MCM, 13,000-volt, grounded neutral, butyl-insulated, shielded, neoprene-jacketed cable delivers more power at lower cost to mine face in Colorado operation.

Go up to bring costs down—with Anaconda Mine Power Cable



Exceptional moisture resistance is provided by Anaconda Type AB butyl insulation, tests show. Type AB absorbs less than half as much moisture after 7 days as specifications permit.

With the trend to higher voltages in the mine – many companies are finding they can bring costs down by using overhead Anaconda butyl-insulated cable.

Cable is out of the way of damage by equipment, is easier to move, better for re-use. And there's no ditch to dig or fill, leaving a solid floor.

Even where moisture is a problem, you can outwit this enemy of long cable life with Anaconda butyl-insulated cable.

Latest tests show Anaconda's Type AB butyl high-voltage insulation absorbs far less moisture than industry standards permit . . . is many times better than competitive materials. And – Type AB's higher tensile strength gives you a stronger, sturdier cable.

New Engineering Bulletin EB-27 has full details on performance of Type AB insulation in 15 Industry Specifications tests. Ask the Man from Anaconda for your copy as well as information about Anaconda Aerial Cable. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 56330

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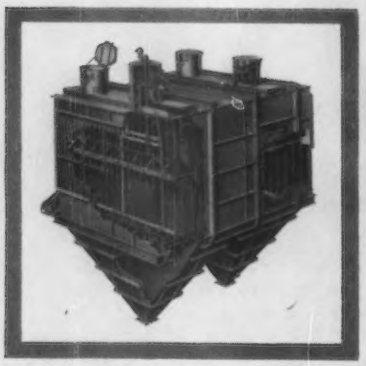
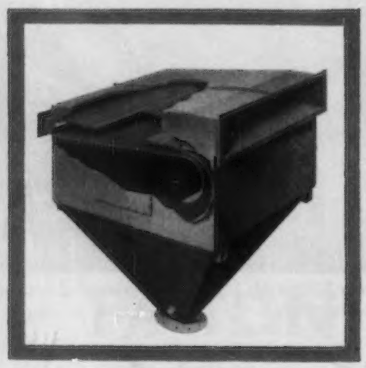
Mastering the double-eddy dust devil leads to extra dust collection efficiency!

DUST IN THIS PART OF THE DOUBLE EDDY WHIRLS UP IN ALL CYCLONES...
BUT BUELL'S EXCLUSIVE "SHAVE-OFF" TRAPS IT...
HARNESSES THE "DUST DEVIL" FOR EXTRA EFFICIENCY!

Other design features which increase efficiency include large, clog-proof diameter, proper proportioning for maximum dust separation, extra-heavy-gauge, wear-resistant construction . . . features which shave dust collection costs to the minimum!



Buell SF Electric Precipitator also delivers *extra dust collection efficiency*, due to unique Spiralectrodes and Continuous Cycle Rapping.



Buell Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations.

For more specific data about Buell's *extra efficiency*, write Dept. 19-B, Buell Engineering Company, 70 Pine St., New York 5, N. Y.

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Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Chile *(Continued)*

Chamber of Deputies by a large majority recently approved agreement reached by U. S. and Chilean governments in order to initiate a large prospecting campaign in search of radioactive minerals in Chile. So far, very little has been done in Chile in search for uranium deposits.

Before a notary, public, Empresa Nacional de Fundiciones opened bids for machinery required to build a copper smelter, an electrolytic refinery and a contact sulphuric acid plant. Three groups of specialized firms, one American and two European presented bids: Allis Chalmers Mfg. Co. and Western Knapp Engineering Co.; Demag A. G. and Klockner-Humboldt-Deutz A. G.; and Fried Krupp, Lurgi Gesellschaft für Chemie und Hüttenwesen M. B. H. and Norddeutsche Affinerie. Special committee of engineers will report to the Board of Directors.

Mining Credit Bank paid to the middle size and small miners just before Christmas, $866,000 for ores and concentrates bought by some of its 20 Agencies.

MEXICO

Power failure early in December has seriously reduced operations at the gold-silver-lead zinc mine in Matchuia, San Luis Potosi, of Negociación Minera Santa Maria de La Paz.

Normally the operation, with a 150 tpd flotation mill, produces about 2,500 tpm of concentrates, all of which are sent to Asarco smelter in San Luis Potosi. Production now reportedly has been reduced by a third.

Breaking of one generator and subsequent damage to three other generators left the operation with only 30% of normal power.

Joseph B. Croze, director, commented that "The loss of our No. 3 engine is a serious setback to our mining operations and will force us to make adjustments particularly where compressed air is essential. The financial loss will be quite heavy and I fear we will have to replace the engine with a new one or with parts almost equivalent to a new unit."

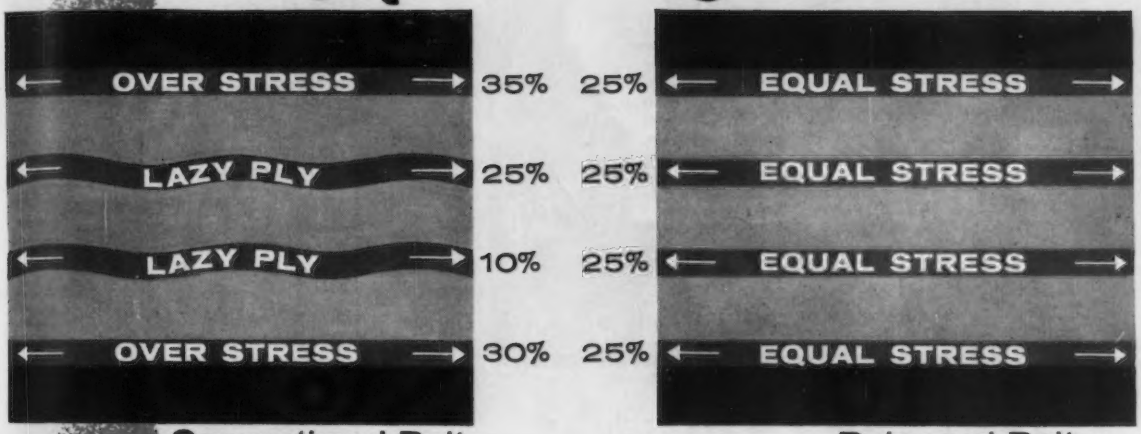
IN THE PHILIPPINES

Samar Mining Co. has announced plans to make its mining area in Sibuguey the biggest source of iron ore in the Pacific Basin.

Manuel Elizalde, president of Elizalde and Co., owners of Samar Mining, recently returned from Japan where he concluded agreements for five Japanese steel mills to absorb his mining company's production.

Japanese steel mills will also under-

Are you paying for "lazy plies" in your belts?



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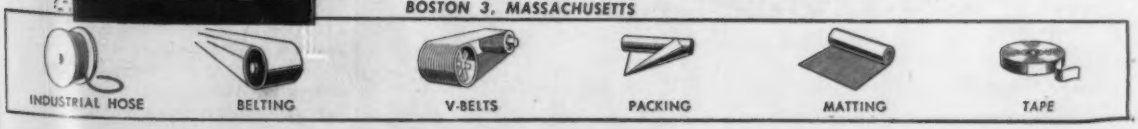

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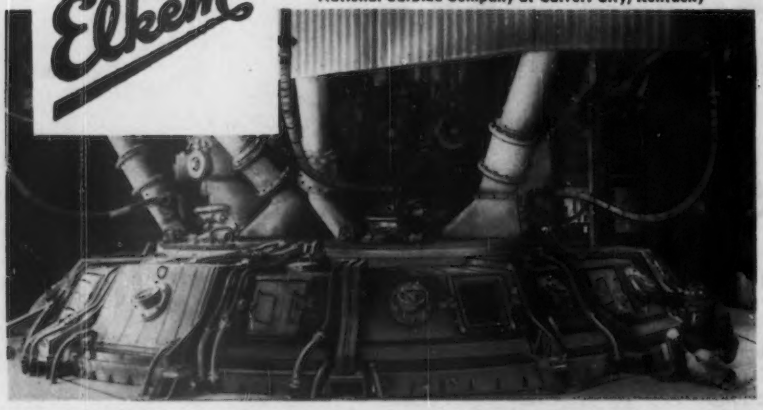
Furnace Platform of 1 of 4-39,000 KVA ELKEM CALCIUM CARBIDE Furnaces installed by National Carbide Company at Calvert City, Kentucky



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Philippines *(Continued)*

write and be responsible for all shipping facilities necessary, the announcement said. Japanese engineers would lay out a 40-km railroad from Sibuguey area to company pier, according to Mr. Elizalde.

Atlas Consolidated Mining & Development Co. reported its copper output at Toledo totalled 2,047,295 lb Cu and 583 oz Au. from milling 180,654 tons, or over 6000 tpd. Mill heads are appreciably higher because of less low grade ore that had come from extensive stripping in earlier months.

Expansion of mill capacity has been unavoidably delayed because of failure to receive some of the equipment from U.S. However, last of the machinery ordered has now arrived and completion of project is scheduled for early 1957. Full milling rate of 10,000 tpd should be reached before April.

Baguio Gold Mining Co. reported its November production at 2661 ozs Au, valued at 308,186 pesos at current market and subsidy prices, about 116 pesos ($58) per oz.

Operations have been resumed by Benguet Exploration Ltd. on its gold property in Baguio. 50-ton mill is being erected. Development since 1946 has revealed several high grade orebodies, said to average about $24 gold per ton with zinc and copper associated. Concentrate will be shipped to foreign smelters.

Mine is managed by Philex Mining Corp. Paul A. Schafer is president. Company also announced plans for erection of a mill to treat copper-gold ores from its Santo Tomas group of claims, located about 20 km south of Baguio where extensive development work opened up a large tonnage of ore. About 9,000 ft of diamond drilling and 2200 ft of underground work have been done.

Paracale Gumaus, an important pre-war gold mine in the Paracale district, has resumed operations and is currently milling about 150 tpd. Ore contains Ag, Cu, and Pb values besides the gold.

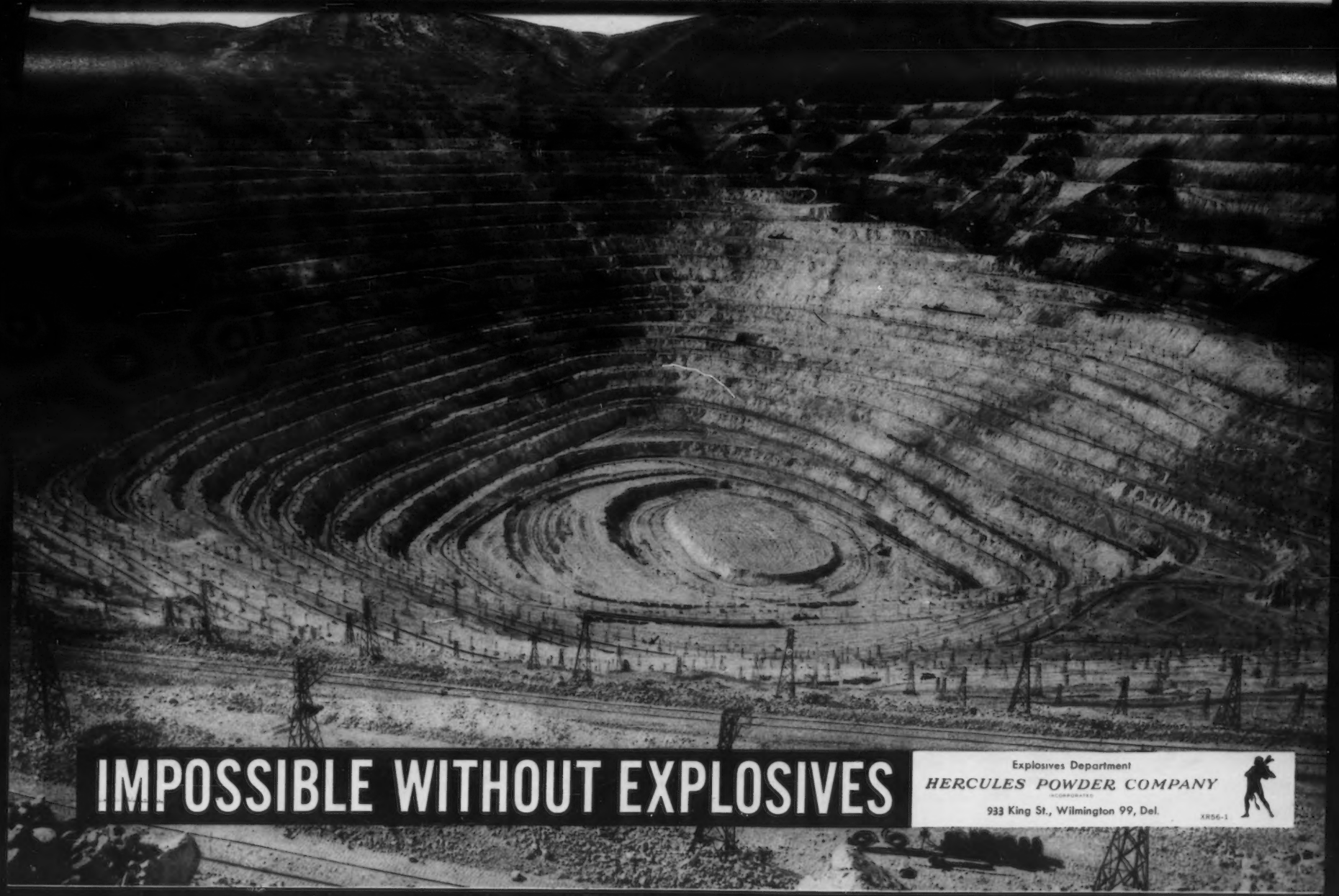
IN AFRICA

Central Mining and Investment Corp. has secured mineral concession over 200 sq miles in Tete area in Portuguese East Africa. According to concession contract gazetted in Portuguese East Africa recently, the company has right to prospect, operate and work all mineral deposits in area, except those of radioactive nature petroleum and other hydrocarbons.

Drilling has been started at Chidue where there are some indications of copper. Portuguese company has been formed in Lisbon to work concessions.

Crown Mines, largest individual mining property on Witwatersrand, is to curtail operations after 59 years, board of directors has announced.

Recent narrow profit margin and pro-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Africa *(Continued)*

gressive exhaustion of gold reserves in parts of mine, where mining will stop soon, will cut operations by 25%.

Largest circular shaft in the world is to be sunk at Saaiplaas Gold Mine, eight miles from Welkom. It is already 42-ft deep and sinking operations will begin in earnest early this year.

Free State Saaiplaas Co. is controlled by New Consolidated Gold Field Ltd. Shaft, which is No. 2, has an internal diameter of 27 ft 6 in. and will be sunk to 6400 ft.

Buffelsfontein Gold Mining Co. officially started production on January 1. Chairman of company, Col. Jack Scott, announced at annual general meeting that sinking and equipping of shafts was completed during July; and that sufficient progress has been made with underground development, stope preparation and construction of reduction plant to enable recent trial milling run.

During next eighteen months about $5-million will have to be spent on housing, underground equipment, railways and other ancillary works to maintain capacity of reduction plant at 100,000 tons a month and establish an adequate ore reserve.

This footage disclosed 100% payability, with an average value of 12.2 dwts per ton over an average reef channel width of 39.4 in., equivalent to 474 in. dwts.

Colonel Scott said that uranium production will start about June 1957 and contract period will run for ten years.

LIBERIA

First flights of airborne magnetometer survey in northwestern Liberia for the Liberian Mining Co., Ltd. got under way Jan. 1. 6,000 sq mile aerial search for iron ore is being performed by Aero Service Corp., Philadelphia, at a cost of about $200,000.

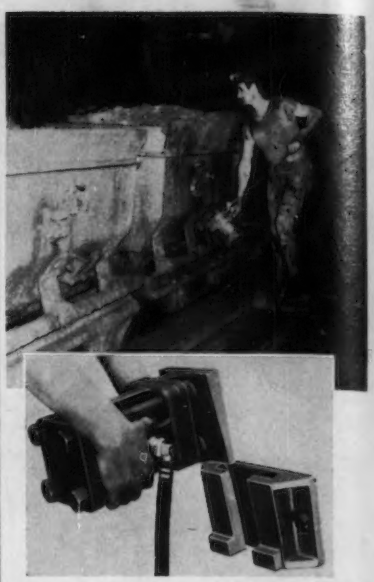
Specially outfitted PBY amphibian plane, equipped with high sensitivity Gulf magnetometer in a "stinger" or tail installation, will be survey plane. Aero Service has also installed Shoran gear in flying boat to guide its flights over dense Liberian jungle.

IN ASIA

INDIA

Russian technicians, now advising Government of India, estimate that daily output of 1,895 carats may be expected from India's largest Panna diamond mines, providing they are scientifically worked.

They have suggested a $10-millions mechanization program, since accepted by New Delhi, to cover these mines and other group in east Indian state of Andhra.



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Sturtevant Rotary Fine Crusher in open position. Five models available — reduce 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. *Request Bulletin No. 063.*

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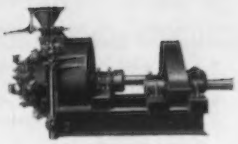
Reduce coarse (5 in. largest model) to fine (⅛ in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smaller sizes operate on double cam principle—crush twice per energy unit. *Request Bulletin No. 062.*



RING ROLL MILLS

Reduce hard or soft 1½ in. and smaller material to from 6 to 200 mesh. Grind only — no screens. Capacities of 3 models range up to 18 tph, depending on model and material. Ring diameters and faces 24 x 7 in.; 45 x 8 in.; 44 x 14 in. *Request Bulletin No. 079.*

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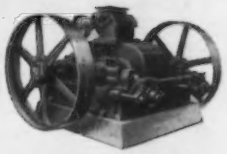

CRUSHING ROLLS

Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls for automatic adjustment in operation; Plain Balanced Rolls; Laboratory Rolls. Recomended for 3 to 1 reduction. *Request Bulletin No. 065.*

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India *(Continued)*

Russian geologists also working at Panna (in north central India) say rock formations here resemble those of Kimberly in South Africa. Their investigations are said to reveal diamond pipes extending over 750 sq miles of this region.

In view of encouraging forecasts, it is almost certain that nationalization and mechanization are twin lines of development which New Delhi soon will pursue. Already, private diamond mine owners have been summoned to Indian capital to discuss compensation.

Gold *(Continued from p 79)*

its exports considerably in 1956 while maintaining relatively stable imports, with the result that it probably had a small balance of payments surplus on current account; the overseas sterling countries as a whole were likewise in approximate balance with nonsterling countries. Britain's trade and economic position thus appeared fundamentally sound. For this reason, and in view of the importance of sterling as a world-wide reserve and trading currency, the International Monetary Fund in December 1956 granted support to sterling on an unprecedented scale by allowing Britain to draw immediately up to $561-million of its quota and by providing for a stand-by credit for the remaining $739-million of the quota on which Britain may draw within twelve months. Toward the year-end, the Export-Import Bank extended to the U. K. a line of credit up to $500-million against the collateral of American corporate securities that had been held by the British Exchange Stabilization Fund since 1940. The British Government has made clear that it intends to keep the rate of the pound sterling at its existing parity and to avoid reimposing any of the controls over foreign trade and payments that it had removed previously. It has maintained monetary, fiscal and other policies designed to restrain demand and moderate the rise in costs and prices in an endeavor to safeguard exports and recapture confidence in sterling.

Many other countries, too, have endeavored to curb inflationary pressures and to restore a sustainable balance in their trade and payments. This endeavor, together with the much greater strength of their economy than only a few years ago, gives grounds on which to hope that the advance toward freer and less discriminatory trade and payments, which slowed last year, may be resumed. In any event, despite the renewed payments difficulties of many countries, there was last year, with a few exceptions, no

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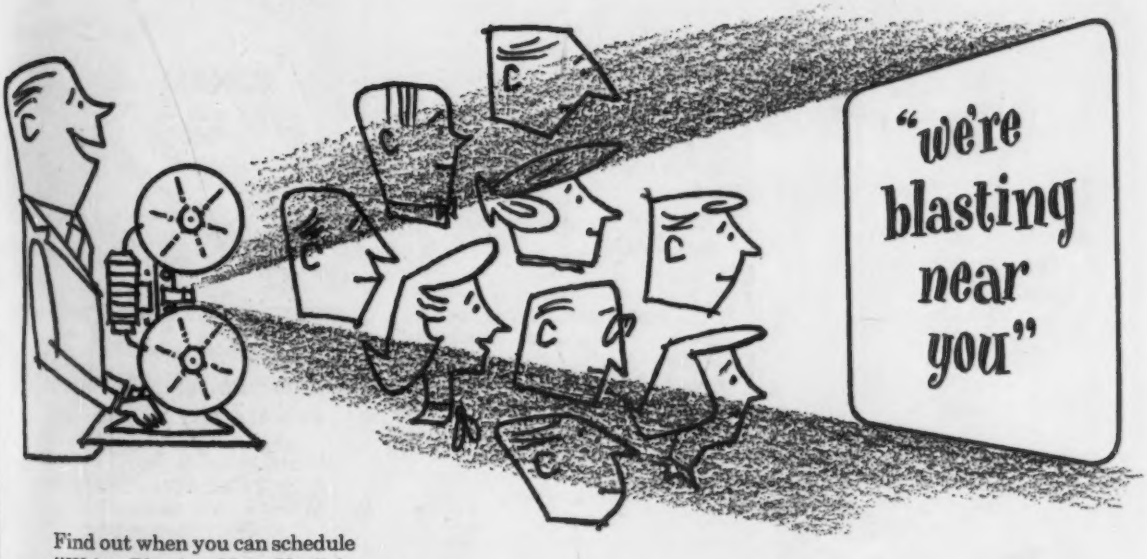
New film...

builds goodwill for users of explosives



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Gold (*Continued*)

relapse into more stringent and discriminatory controls over trade and payments. On the contrary, measures continued to be taken to free trade and payments; and even though they were relatively small, they had an important cumulative effect when superimposed on past achievements. Toward the year-end, consideration was being given to the formation of a "common market" in Continental Western Europe with which the U. K. was to associate itself in a "free trade area" for all but agricultural products. Arrangements of this sort would be a further step forward, provided they did not lead to a widening of trade and payments restrictions against other countries, including the U. S.

Freer and less discriminatory trading and payments are one of the main objectives of U. S. international economic policies. For this reason, the U. S. has regarded the rebuilding of gold and dollar reserves by foreign countries as a healthy sign of a gradual strengthening of their balances of payments—the strengthening being itself the outcome of growing agricultural, mineral and industrial output and of a much better balance in their domestic economies. Last year was the fifth consecutive one during which aggregate gold and dollar reserves of foreign countries have risen, in many of them to levels that are adequate for a more meaningful convertibility of their currencies into dollars than that attained so far. Of these reserves, a considerable portion has accrued from new gold production, but the bulk has been earned by foreign countries through their transactions with the U. S.

Most of the dollars that foreign countries have thus acquired have not been converted into gold, but are being kept in the form of deposits with U. S. banks and invested in U. S. Treasury bills and other securities. The dollar has thus become more and more a currency in which other countries are keeping a portion of their monetary reserves. The foreign-held dollars are a potential claim against goods and services produced in this country or other assets. From the monetary viewpoint, these dollars, which to their owners abroad are assets, are of course liabilities of the U. S., and concern is sometimes being expressed over their size and its implications with respect to our own gold position.

Such apprehensions disregard, however, the fact that in a world in which the dollar has emerged as the leading currency, much of the foreign dollar holdings represents funds needed by

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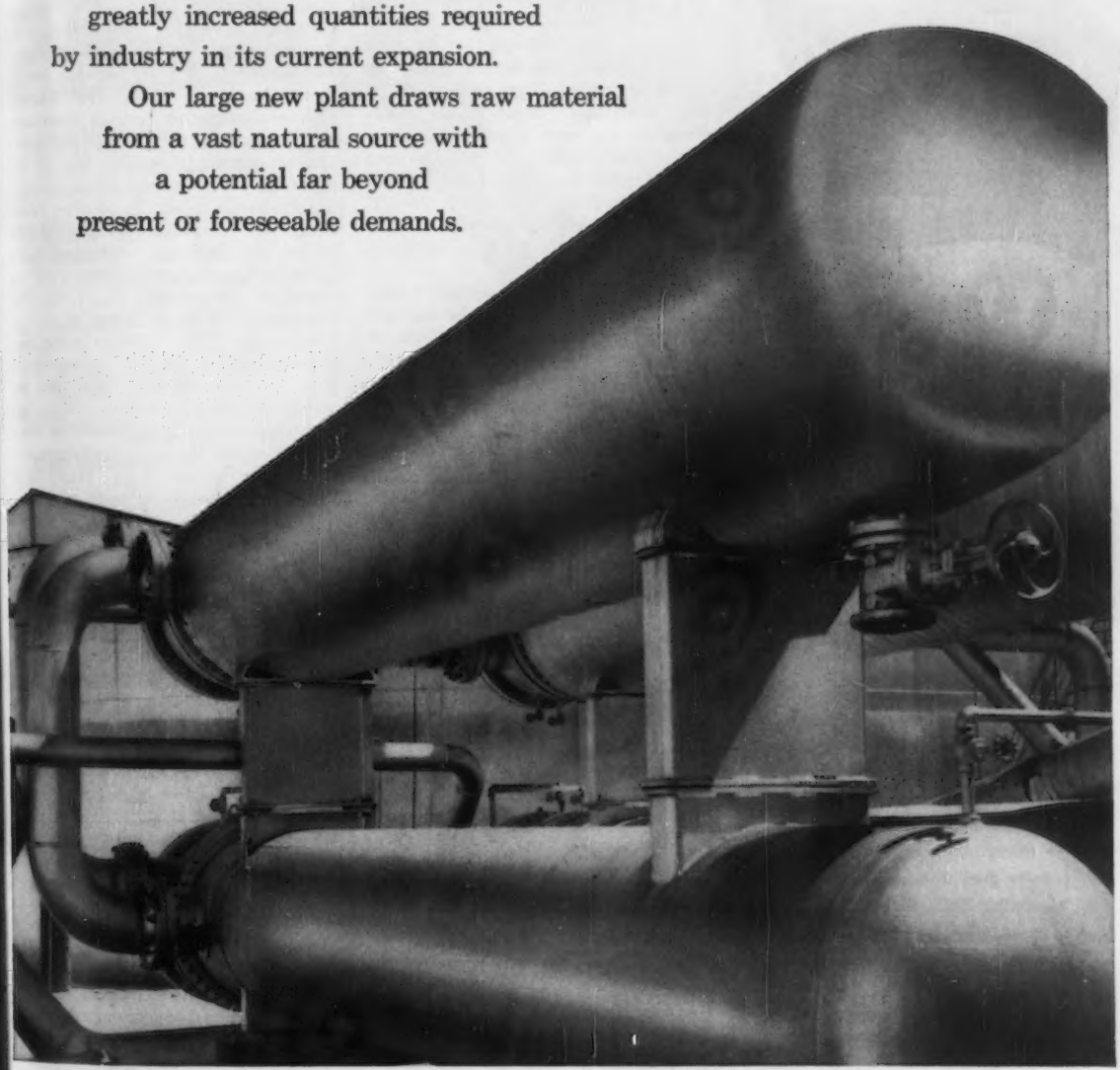

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Wellington, Ohio

Gold *(Continued)*

foreign banks and other businesses for carrying out international transactions. Of the $13.2-billion held by foreigners in September 1956, $5.3-billion was held by commercial banks and business firms largely as working balances; these holders cannot purchase gold from the U. S., although they may sell their dollars to their respective monetary authorities, which may acquire gold from the U. S. The remaining $7.9-billion represented assets of foreign monetary authorities, which could be used to purchase gold from the U. S.; a large part of these assets consists, however, of operating balances that foreign central banks and exchange stabilization funds maintain to meet current exchange requirements or in order to intervene in foreign exchange markets. By and large, therefore, the rise of foreign-held dollars is the outcome of the growth of New York as an international money center.

It is also the result, as already noted, of the "cash" deficits in the balance of payments of the U. S. The bulk of the foreign-held dollars has been acquired through transactions of foreign countries with the U. S. Most of these transactions are of a commercial character—payments for imports of goods and services by the United States, as well as proceeds from U. S. lending abroad; part, however, reflect receipts of dollars under U. S. Government "defense support" and certain other aid programs, as well as Government outlays for goods and services abroad, including military expenditures, which do not count as a form of aid. These dollar receipts differ from normal commercial transactions in that they are based on strategic and military rather than economic considerations; even though there is not much likelihood of their ceasing in any discernible future, they may well decline. Another factor in the outflow of dollars is the rising U. S. private investment abroad; as "cash" dollar transfers are made to foreign countries, short-term U. S. liabilities to foreigners are of course increasing but at the same time U. S. investors are acquiring long-term assets in foreign countries. In 1956, such "cash" transfers to foreign countries consequent upon U. S. long-term investment were an especially important factor in the build-up of dollar holdings of certain foreign countries. Even more important, many foreign countries, as they have rebuilt their monetary reserves to more adequate levels, are now disposed to spend more of their current dollar earnings for purchases in the U. S. or elsewhere. Many have already reduced their trade and payment restrictions in order to secure more goods, and this freeing of imports can be expected to continue since there will be less need, for balance-of-payments considerations, of maintaining direct controls over imports. For these and other reasons, the "cash" balance-of-payments deficits of the U. S. are likely to decline with the passage of time; a continuing rise in foreign dollar holdings can by no means be taken for granted.

Most decisive of all, foreign countries are holding a large part of their monetary reserves in the form of dollars because their need for dollar assets has greatly increased during recent years, as the foreign trade of the U. S. has greatly expanded and multilateral settlements in dollars have become important even in nondollar trade. The U. S. dollar—universally acceptable as it is as a means of international payments—thus performs an essential role in the international relations of the U. S. as well as in the entire economy of the Free World. It performs this role because of its intrinsic strength, which comes to it from the productivity, the adaptability, and the resiliency of the American economy. It is up to the U. S. to pursue policies—monetary, fiscal and other—that will maintain the confidence of other nations in the dollar●

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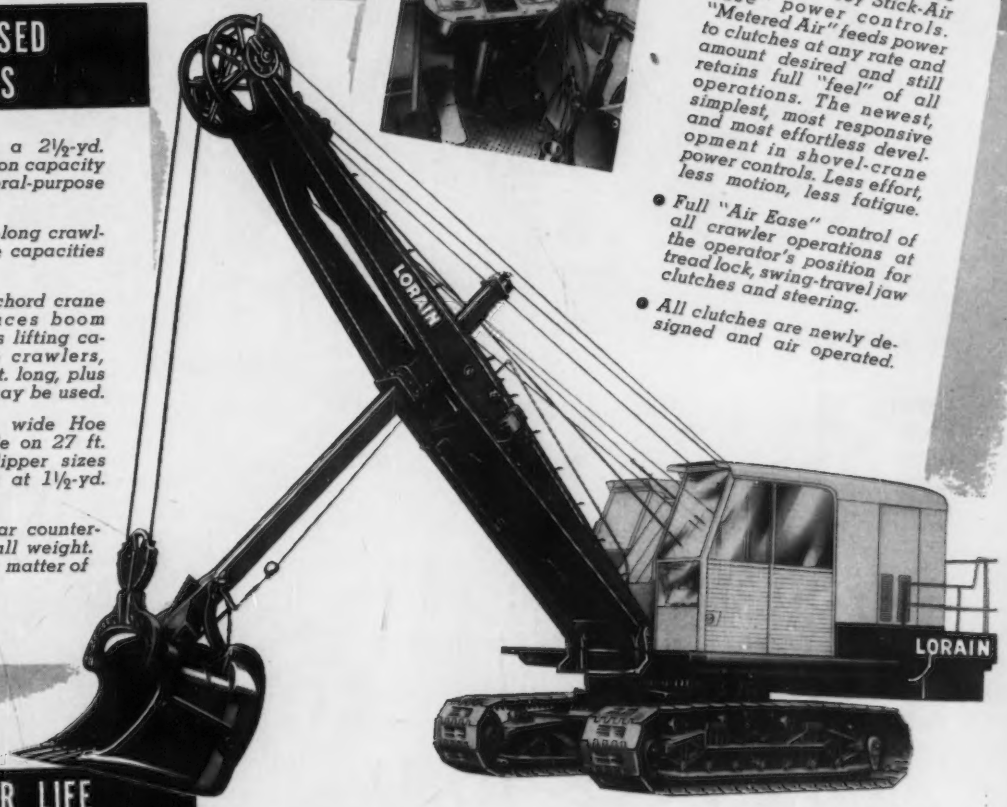

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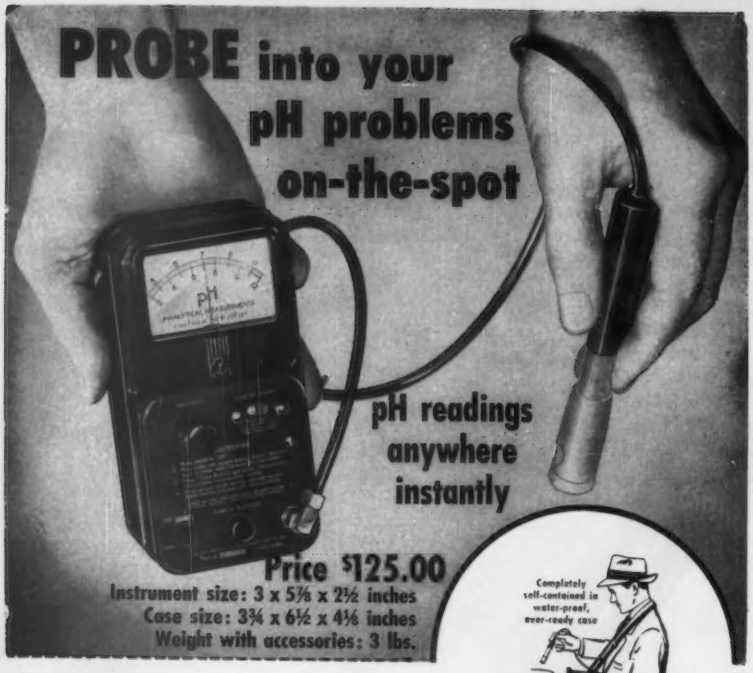

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NEW PATENTS

(Continued from p 185)

Earth Moving Hydraulic Suction Nozzles. K. O. F. Jacobsen. 12-18-56. 2,774,569.

An improved, non-clogging, hydraulic suction nozzle to be used for moving earth.

Decomposition of Titaniferous Ores. A. G. Oppegaard (assigned to National Lead Co., New York, N. Y.). 12-18-56. 2,774,650.

In a process for decomposing ilmenite or other titaniferous materials, quantities of ground ore are treated separately, one with concentrated sulphuric acid and the other with hydrolysis acid. The two reaction products are then combined in water to form a solution having a basicity of 15 to 25%. Hydrolyzing this solution produces a titanium hydrate, plus hydrolysis acid suitable for re-use in the system.

Heat-treating Fines in a Coarse Solids Fluidized Bed. F. S. White (assigned to the Dorr Co., Stamford, Conn.). 12-18-56. 2,774,661.

Fluidized-bed apparatus and process suitable for the treatment of sulphidic-sulphur bearing metal ores, red mud derived from Bayer Process, and the like. Treatment takes place in presence of a fluidized mass of incandescent particles large enough to resist entrainment in rising gas stream.

Heavy Medium. F. Rodis and F. Thomas (assigned to Knapsack-Griesheim Aktiengesellschaft für Stickstoffdünger und Autogentechnik, Knapsack, Bezvik Koln, Germany). 12-18-56. 2,774,734.

Improved fluid for use in heavy media separation is made by mixing water or other liquid with ferrosilicon particles possessing rounded or oval elongated shapes instead of the usual sharp edges.

Submarine Seismic Prospecting. E. J. Toomey (assigned to Texas Instruments Inc., Dallas, Tex.). 12-18-56. 2,774,955.

Improved method and apparatus for use in the seismic investigation of geological formations that lie under bodies of shallow water.

Selenium Dioxide Volatilization Process. Y. E. Lebedeff, J. R. Stone and P. W. von Stein (assigned to American Smelting & Refining Co., New York, N. Y.). 12-25-56. 2,775,509.

Process for recovering selenium dioxide from slimes, anode muds and similar material produced during electrolytic refining of impure copper. Slime is heated under oxidizing conditions, and selenium dioxide is volatilized without decopperizing the material.

Treating Nickel-Bearing Iron Ores. E. B. Mancke (assigned to Bethlehem Steel Co., a corporation of Pa.). 12-25-56. 2,775,517.

Process for treating high-nickel iron ores, for example, those of the Mayari type, to produce a material suitable for use in producing iron. Ore is roasted with alkali, and then leached with aqueous solution containing an iron salt.